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# ENCYCLOPÆDIA EDINENSIS:

OR

# DICTIONARY

OF

# ARTS, SCIENCES, AND LITERATURE.

IN SIX VOLUMES,

INCLUDING ALL THE MODERN IMPROVEMENTS TO THE PRESENT TIME; AND ILLUSTRATED
WITH UPWARDS OF ONE HUNDRED AND EIGHTY ENGRAVINGS.

*KNOWLEDGE IS POWER.*—Bacon.

VOLUME FIFTH.

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# ENCYCLOPÆDIA EDINENSIS.

**MATRICULA**, a register of the admission of officers and others into any body or society. Two kinds of matriculæ are mentioned by ecclesiastical writers; the *matricula clericorum*, and the *matricula pauperum*. Those who are admitted into our universities are said to be matriculated. The term matricula also applied formerly to a kind of alms-house, and even to the church.

**MATRIX**, or MATRICE, the uterus. See ANATOMY and MIDWIFERY. Matrix likewise refers to the generation of vegetables, minerals, and metals; and is employed, in a figurative sense, to moulds for casting printers' letters, or for striking medals or coins.

**MATROSSES**, in the artillery, are soldiers who assist in loading, firing, and sponging the guns, and who likewise carry fire-arms.

**MATT** denotes interwoven rope-yarn, which is applied to the yards of a ship, to preserve them in hoisting and lowering.

**MATTER**. See MECHANICS.

**MATTHEW**, ST. the first of the four Evangelists, was a native of Galilee, a Jew by birth, and employed, previous to his apostleship, as a publican or tax-gatherer to the Romans. After our Lord's ascension, he continued eight years preaching in Judea; at the expiry of which period he removed to Ethiopia, where it is supposed he suffered martyrdom, in a city called Nadebbar. His Gospel is thought to have been commenced in Judea, in the year 41, that is, eight year's after Christ's ascension; and, according to some, it was written in the Hebrew or Syriac language, though the Greek version is as old as the apostolic times. Dr Henry Owen has fixed the date of this publication about the year 38; but although the learned differ upon this point, yet all antiquity unanimously agree, that his Gospel was compiled for the service of the Jews in Palestine, to confirm those who believed, and to convert, if possible, those who believed not.

**MATINS**, in the Romish church, signifies the first canonical hour, or the first part of the daily service.

**MAUNDY-THURSDAY**, or MANDATE-THURSDAY, the Thursday in Passion-week, which is held in commemoration of the institution of the Lord's Supper, or of the day on which our Saviour washed the Apostles' feet and instructed them to love one another.

**MAUPERTUIS**, PETER LOUIS MOREAU DE, a celebrated French mathematician, born at St Malo in 1698, and died in 1759. He entered the college of la Marche, at Paris, in his 16th year, and five years afterwards he entered the army; but being passionately fond of the study of mathematics, in which he had made very great progress, he, in 1723, renounced the military profession, and was then admitted into the Royal academy. His energy in the pursuit of science received a new impulse when he became an implicit follower of the immortal Newton; and the fruits of his indefatigable application to study were, between the years 1724 and 1744, communicated to the academy, in a considerable series of invaluable memoirs. In consequence of an invitation to Berlin in 1740, he was present with the king of Prussia at the battle of Molwitz, and was taken prisoner to Vienna; but he was enabled to return to Paris in 1742. Being at this time appointed director of the academy of Sciences, he, in the following year, had the honour of being admitted a member of the French academy. Repairing to Berlin in 1744, he married Mademoiselle de Borck,—was, by his Prussian majesty, chosen president of the royal academy of Sciences of that city, and had likewise the order of Merit conferred upon him. Maupertuis was not unfrequently engaged in controversy with eminent characters, one of whom, in particular, was Professor Koenig of Franeker, together with Voltaire. During the latter years of his life his health obviously declined, owing to the laborious study to which he had habitually subjected himself; yet his powerful faculties continued to the last unimpaired; and, indeed, many of his writings were composed in the time of confinement from severe indisposition. Amongst his various works are, The Figure of the Earth determined; The Measure of a Degree of the Meridian; A Discourse on the Parallax of the Moon, and one on the Figure of the Stars; Elements of Geography and of Astronomy; Essays on Cosmography, on Moral Philosophy, on the Progress of the Sciences, and on the Formation of Bodies; An Eulogium on M. de Montesquieu; and Reflections on the Original Languages.

**MAURICE**, ST. a town of Switzerland, situated on the Rhine, and between two high mountains. It forms the chief entrance from the canton of Bern into the Vallais.

MAURITANIA, or MAURUSIA, an ancient kingdom of Africa, bounded on the north by the Mediterranean, on the west by the Atlantic, and on the south by Getulia, or Libya Interior. The Mauri were the first inhabitants, and the earliest princes were Neptune, Atlas, and Antæus. In course of time it became a Roman province. The inhabitants are said to have been first taught the use of the sword by Belus, the son of Neptune. Shields formed of elephants skins were used by the infantry; and besides targets or bucklers, made also of skins, the cavalry were provided with lances. Their horses were singularly swift and docile. The Mauritanians had little or no idea of agriculture; and their mapalia, or tents, were very incommodious dwellings.—Their food, which was sometimes eaten without any preparation, consisted of corn, herbage, &c.; and their clothing, both in summer and winter, was chiefly composed of a very coarse tunic, under which another equally coarse or tattered garment was worn. It appears, from Horace, they understood the preparation of poisons, which they are said to have applied to their arrows. They are likewise supposed to have sacrificed human victims to their deities.

MAURITIUS, an island in the Indian ocean, situated 400 miles to the eastward of Madagascar, is about 150 miles in circumference, and contains two convenient harbours on the east and west sides. The mountains are numerous, and the summits of several of them are covered with snow. The valleys, which are watered by different rivers, are well cultivated and remarkably fruitful. This island affords the best ebony in the world, besides which indigo and coffee are the principal produce; and cattle, goats, sheep, and deer, are exceedingly abundant. The town of Port Louis is strongly fortified, and contains many commodious warehouses and other conveniences for trade. Mauritius was first discovered by the Portuguese. The Dutch settled in it in the year 1598, and named it after Maurice, their stadtholder. Having been abandoned for a period, the French, in 1720, took possession of it under the new denomination of the Isle of France; but it was ceded to the British in 1814.

MAUSOLEUM, a splendid sepulchral monument. See ARTEMISIA.

MAXILLA, the jaws. See ANATOMY.

MAXIM, an established principle, often used in the same sense as axiom.

MAXIMUM, in mathematics, is opposed to minimum, and denotes the greatest possible value of a variable quantity. The maxima and minima of quantities were clearly discussed by the ancients; and, among the moderns, Fermat appears to have been the first who thoroughly studied the subject.

MAY, the fifth month of the year, contains thirty-one days, and on the twenty-first the sun enters Gemini. The name is supposed to be derived from *majores*, the ancient appellation of the chief men in the Roman territory; or from the circumstance of sacrifices having been offered in this month to Maia, the mother of Mercury.

MAYENNE, so called from the river of the same name, is a department of France, including part of the old province of Maine; is bounded on the north by the departments of La Manche and Orne, on the west by the department of the Ille and Vilaine, on the east by that of the Sarthe, and on the south by that of the Maine and Loire; is about 22 French leagues in length, and 16 in breadth, and is hilly, and in a great measure covered with forests. Few of the plains are adapted for cultivation; but the soil bordering on the rivers Sarthe and Mayenne is very productive of pasture, grain, and fruits. Laval is the capital.

MAYER, TOBIAS, an indefatigable German astronomer and mathematician, born at Maspach in 1723, and died in 1762. He was remarkable for mechanical ingenuity at a very early age, and soon acquired a knowledge of mathematics and of the Latin tongue. The professorship of mathematics at Gottingen was conferred upon him in 1750; and the Board of Longitude rewarded him with L.3000 as a premium for his theory of the moon and his astronomical tables and precepts.

MAYO, one of the Cape Verd islands in the Atlantic, is about 21 miles in circumference, and produces corn, yams, potatoes, plantains, and fruits. Salt is the staple commodity; and the sea affords abundance of fish. Pinosa, the chief town, is inhabited by negroes, who speak the Portuguese language.

MAYO, a county of the province of Connaught in Ireland, bounded on the north and west by Sligo and the Atlantic, on the south by the county of Galway, and on the east by Roscommon; derives its name from an ancient city, some of the ruins of which still remain. This county is about 62 miles in length, and 52 in breadth, and is divided into 68 parishes. The northern and western parts present a mountainous and bleak aspect; but the southern and eastern districts are productive of corn and flax. Croagh-Patrick is the highest mountain. In the vicinity of Cong are several remarkable caverns and subterraneous waters, likewise turlachs or plains which, in winter, are overflowed with water, but in summer become rich in pasture. Several rivers and lakes water the interior; and Castlebar is the principal town.

MAYOR, the principal magistrate of a city, chosen annually from among the aldermen. Mayors of corporations are justices of the peace *pro tempore.* The office was first instituted by Richard I. in 1181; and it is enacted, that none can be elected to the magistracy who has not received the sacrament, according to the Church of England, one year previously, and also taken the oath of supremacy. The courts belonging to the lord mayor and city of London are the Hustings, which respect the laws, rights, franchises, and customs of the city; the court of Request, or of Conscience; that of the lord mayor and aldermen, and in which, likewise, the sheriffs sit; the court of Common Council, for the making of all bye-laws; the Chamberlain's court; the courts of Coroner and of Escheator,—one for the conservation of the river Thames, and one of jail delivery; likewise two courts of sheriffs, and the court of the City Orphans.

MAZARINE, JULIUS, was born at Piscina in Italy in 1602, and died at Vinciennes in 1661. While in the service of cardinal Sachetts, his political influence in effecting the peace of Queiras prepossessed cardinal Richlieu in his favour; and, in 1641, Louis XIII. obtained for him a cardinal's hat. Being entrusted with the management of affairs in France during the minority of Louis XIV. the seeming severity of his measures was in 1648 the occasion of much civil discord; he himself was denounced a public disturber of the peace, and, after a temporary reconciliation, was actually banished the kingdom in 1650. He, however, resumed his authority at Paris in 1653, and, not only by the parliament, but by the people at large, was hailed with the utmost enthusiasm. Mazarine possessed remarkable talents; but his reputation was sullied by an avaricious propensity.

MAZOLOGY. See Mammalia.

MEAD, an agreeable liquor, which is thus prepared: To four gallons water, with as much honey as will make it bear an egg, add the rinds of three lemons. After boiling and carefully scumming, take it off the fire, and add the three lemons cut into pieces. The whole being then poured into a vessel, is again scummed after three days' working, and the clear part poured into a cask, which is closed when the hissing noise discontinues, and it is fit for bottling at the end of three months. The flavour is improved by the addition of ground cloves, mace, and nutmeg.

MEAD, Richard, an eminent English physician, born at Stepney in the vicinity of London. Having received a liberal education in his father's house, he, in his 16th year, removed to Utrecht, where he underwent a course of study; and thence to Leyden, at which place he spent three years in the study of medicine and botany. He then went to Italy, obtained his medical degree at Padua, and, after visiting Naples and Rome, returned to his native place. In 1703 he became a member of the Royal society, and was appointed physician of St Thomas's hospital; and four years afterwards he was honoured with a diploma from the university of Oxford. As a professional man and a scholar, Dr Mead was held in deserved estimation; he was chosen physician to George II. in 1727; and he died, in 1754, at the advanced age of 81 years. Dr Mead was uniformly a liberal patron of science and literature; and he cultivated a correspondence with the most respectable literary characters of Europe. Amongst his principal works are, a Treatise on the Scurvy; De Variolis et Morbilis Dissertatio; Medica Sacra; Monita et Præcepta Medica; and a Discourse concerning Pestilential Contagion. His Latin works were translated into English by Thomas Stack, M.D.

MEAN, the medium between two extremes, as an arithmetical mean, a geometrical mean, mean distance, mean motion, &c. The term has various applications, being of frequent use in the sciences.

MEASLES, a cutaneous disease, attended with fever and other symptoms. See Medicine.

MEASURES are certain quantities employed for the purpose of ascertaining the relation that exists between other quantities. There must, consequently, be various measures corresponding to the different natures of those articles that are to be measured,—as linear or longitudinal measure for length, square or superficial measure for surfaces, and solid or cubic measure for those bodies that have length, breadth, and thickness. These measures may either be arbitrarily assumed, to suit the convenience of any age or nation, or immutably fixed according to some determined principle which nature invariably preserves the same. In either case, one unit being fixed, all the other measures of length, superficies, solidity, and weight, can easily be derived from it, by rules of the greatest simplicity. The ancients seem to have taken up this problem in the simplest and most natural manner, and to have derived their measures from those parts of the human body which bear the same name, as the hand, the foot, the cubit, or elbow, the ulna, or arm, &c.; but as these varied according to the different dimensions of those persons from whom they were taken, it soon became necessary, as civilization advanced, to fix a more general standard, which each nation endeavoured to effect by some particular expedient. Henry the First of England ordained that the measures used in his kingdom should be adjusted according to the length of his own arm. The Romans regulated their measures by the dimensions of some of their most durable buildings, and for this purpose the Egyptians employed the base of one of their pyramids. Thus the necessity of each was supplied as long as it remained a separate and distinct nation; but when commerce united them all into one, similar irregularities again arose; and the same spirit that first induced mankind to establish a general standard for particular kingdoms, now prompted them to carry these improvements still further, and to endeavour to establish a uniformity of measures over all the civilized nations on the surface of the earth. Feeling, however, the difficulty of distinctly ascertaining the precise dimensions of former measures, they found that it was not only necessary to establish a general standard by which a uniformity of measures might be produced in every nation, but that this standard should also be perpetual, so as to communicate to posterity a just and accurate idea of those measures that had been employed by preceding ages. But as all material substances are subject to decay, a uniform and perpetual standard could only be looked for among those quantities which continue the same in every place and in all ages of the world. Accordingly, philosophers began an indefatigable search for such a standard, and proposed various contrivances for this purpose; but few of them seem worthy of consideration, excepting those that were founded upon experiments made by pendulous bodies, or deduced from the measurement of lines upon the surface of the earth. The celebrated Huygens, in his *Horologium Oscillatarium,* first proposed the distance between the points of suspension and oscillation of a seconds pendulum, as a universal standard of lineal measure, a third part of which he denominated a horary foot. But as this standard is liable to the inconvenience of varying in different latitudes, on account of the spheroidal figure of the earth, it would be improper for each place to have its foot equal to a third part of it, otherwise every foot would vary in length according as that place at which it was adjusted approached to or receded from the equator; a universal standard, therefore, could only be derived from this method by an accurate measurement of the pendulum for some particular latitude, and each nation adopting the result as the standard of their measures. Such a measurement, however, had not at that time been completely obtained, although Huygens himself approached it with considerable accuracy, and in the course of his experiments discovered some remarkable properties that it contained, which have been highly advantageous to those who have subsequently turned their attention to the same subject. Still his measurements were neither so exact, nor his experiments so complete, as to enable mankind to rely upon them with confidence as always producing a certain invariable quantity from which their weights and measures might be derived. Accordingly, in 1775, the society of Arts in London, offered a premium of 100 guineas, or a gold medal, "for obtaining invariable standards for weights and measures, communicable at all times and to all nations;" and in consequence of this, a Mr Hatton proposed to them a modification of the preceding plan, which consisted in applying a moveable point of suspension to a single pendulum, so as to make it perform the part of two, it being first suspended from one point, and the number of vibrations marked in a given time, and afterwards suspended from another point, and the number of vibrations again noted in the same time,—then the distance between the points of suspension, or the space passed over by the moveable point, was the standard proposed. Mr Whitehurst, in an essay published 1787, entitled "An Attempt towards obtaining invariable Measures of Length, Capacity, and Weight, from the Measurement of Time," considerably improved upon this method. Instead of a single pendulum with a moveable point of suspension, he employed two, the difference of whose lengths was to be his standard of measure. The principal superiority which his method appeared to possess over Mr Hatton's consisted in the judicious choice of his pendulums, both with regard to length and the relative number of their vibrations. His object was to have the vibrations of the one pendulum double those of the other, and the length of each expressible in whole numbers of the common scale, while their difference was likewise to be of a convenient length. Assuming, therefore, the seconds pendulum in the latitude of London to be 39.2 inches, he found that one which vibrated 42 times in a minute would be 80 inches long, and that another which vibrated with twice this velocity would be 20 inches, while their difference, 60 inches or five feet, was proposed by him as a standard. But his experiments were not altogether successful; for, in trying to verify them, instead of 60 inches, as it ought to have been, the difference only amounted to 59,892, a discrepancy which resulted from assuming a false length of the seconds pendulum. Mr Whitehurst, however, so far accomplished his design, as to show how an invariable standard might be found for any particular place in a given latitude; in consequence of which, and of the growing inconveniences that were felt from the want of some unalterable standard, a bill was at length brought into Parliament for adopting the quantity so obtained as a standard unit of lineal measure. The proposal was nevertheless rejected; and though subsequent attempts have been made, the plan has never received the sanction of government. A proposal of the same kind was also made in America; and on a motion of Mr Jefferson, the house of representatives resolved that the length of the pendulum for latitude 38° should be adopted as the basis of a system of weights and measures throughout the United States. This proposal, however, like that in England, was never carried into effect, although sanctioned by a decree of the legislature. France afterwards embraced the subject under the same view, and appointed a commission of the ablest mathematicians both of that country and of England, accurately to measure the pendulum for some particular latitude. That which they agreed upon as most suitable for their purpose was 45°, which, from its mean distance between the poles and equator, was regarded as best calculated for ensuring a general reception. But the method, after a full and mature investigation, was objected to as containing a heterogeneous element, time, which was as difficult to measure as the pendulum itself; and afterwards, by the advice of La Place, and some other of the most able among the French academicians, it was entirely abandoned. They then proposed, that some invariable line upon the surface of the earth should be adopted as the basis from which their system of measures might be derived; and as the length of a meridian was considered the same in every latitude, they selected it as best adapted for the purpose required. A quadrant of this meridian was then computed by measuring an arc of it between the parallels of Dunkirk and Barcelona, which was found to be 5130740 French toises; the ten millionth part was denominated a *metre*, and is equal to 36.9413 French inches, or 39.3708 English inches. This new standard being fixed, they divided it decimally, a method which is both natural and philosophical, and adopted a nomenclature of equal simplicity. The words *deca*, *hecto*, *kilo*, &c. prefixed to the unit of each particular measure, expresses its successive multiplication by ten, while *deci*, *centi*, *milli*, &c. represents its corresponding division; thus a decametre means ten metres, a decimetre the tenth part of a metre; a hectometre, a hundred metres; a centimetre, the hundredth part of a metre, and so on. In like manner, all the other measures are derived from the metre. The *are*, which is the unit of superficial measure, is a square decametre; the *stere*, or unit of solid measure, is a cubic metre; the *litre*, which is a cubic decimetre, is the unit of liquid measure, and all other measures of capacity; and lastly, the *gramme*, which is the weight of a cubic centimetre of distilled water at a given temperature, is the standard of all weights. Notwithstanding the obvious simplicity by which this system is recommended, such was the interruption of commercial intercourse occasioned by it, and such the obstructions opposed to it by the prejudices and inveterate habits of the people, that it was found necessary, first to modify, and afterwards partially to abandon it, and again to renew to a certain degree the old appellations and divisions. Besides, the system is founded upon an accurate measurement of a quadrant of the meridian, when it is uncertain whether any such measurement can ever be obtained. Hence, it appears, that a preference can scarcely be given to any of those methods that have yet been proposed for establishing a more uniform system of weights and measures; and that difficulties almost insurmountable oppose each of them, which will most likely prevent them from ever becoming practicable in any nation. England, aware of these difficulties, and of the danger of rashly destroying those institutions that are capable of amelioration, has wisely thought proper to continue the weights and measures that were formerly in use throughout this country, and endeavoured to reduce them to uniformity, by a bill which was brought into Parliament in 1823, wherein it is proposed, that Bird's scale of 1760 shall be adopted as the only standard from which all other measures of length, superficies, and solidity shall be derived. This scale has been ascertained by the commissioners of weights and measures to have to a pendulum vibrating seconds of mean time in the latitude of London, in a vacuum at the level of the sea, Fahrenheit's thermometer being at 62°, the ratio of 36 to 39.1393. It has also been found to bear,

| | |
|---|---|
| To General Lambton's scale the ratio of | 36 to 35.99934 inches. |
| Sir George Shuckburgh's, | 35.99998 |
| General Roy's, - | 36.00088 |
| The Royal Society's standard, | 36.00135 |
| Ramsden's bar, - | 36.00249 |

In the same act, it is also proposed that the brass Troy pound made in 1758 shall be the original and genuine standard measure in weight, from which all others shall be derived. This Troy pound contains 5760 grains, 7000 of which make a pound avoirdupois, and 262.724 are equal to a cubic inch of distilled water in a vacuum, measured by brass weights also in a vacuum, at the temperature of 62° of Fahrenheit's thermometer. It is further proposed, that the standard measure of capacity, as well for liquids as for dry goods, shall be the gallon containing 10 pounds Avoirdupois weight of distilled water weighed in air, at the temperature of 62° of Fahrenheit's thermometer, the barometer being at 30 inches; and, lastly, it is proposed that all weights and measures shall be taken in parts and multiples, or certain proportions of these standards, as given in the tables.

## TABLES OF WEIGHTS AND MEASURES.

### I. FOR ENGLAND.

#### 1. *Linear Measure.*

| | | |
|---|---|---|
| 12 Inches, | = | 1 Foot. |
| 3 Feet, | = | 1 Yard. |
| 5½ Yards, | = | 1 Pole or perch. |
| 40 Poles, | = | 1 Furlong. |
| 8 Furlongs, | = | 1 Mile. |
| 60 Geographical or 69.04318 English miles, | = | 1 Degree. |

#### 2. *Cloth Measure.*

| | | |
|---|---|---|
| 2¼ Inches, | = | 1 Nail. |
| 4 Nails, | = | 1 Quarter. |
| 3 Quarters, | = | 1 Flemish ell. |
| 4 Quarters, | = | 1 Yard. |
| 4 Quarters 1 inch, | = | 1 Scotch ell. |
| 5 Quarters, | = | 1 English ell. |
| 6 Quarters, | = | 1 French ell. |

#### 3. *Square Measure.*

| | | |
|---|---|---|
| 144 Square inches, | = | 1 Square foot. |
| 9 Square feet, | = | 1 Square yard. |
| 30¼ Square yards, | = | 1 Square pole. |
| 40 Poles, | = | 1 Rood. |
| 4 Roods, | = | 1 Acre. |
| 640 Acres, | = | 1 Square mile. |

#### 4. *Cubic or Solid Measure.*

| | | |
|---|---|---|
| 1728 Cubic inches, | = | 1 Cubic foot. |
| 27 Cubic feet, | = | 1 Cubic yard. |
| 40 Cubic feet of rough or<br>50 of hewn timber, | = | 1 Load. |
| 42 Cubic feet, | = | 1 Ton of shipping. |
| 5451776000 Cub. yds. | = | 1 Cubic mile. |

#### 5. *Wine Measure.*

| | | | | |
|---|---|---|---|---|
| 4 Gills, | = | 1 Pint, | = | 28.875 Cub. in. |
| 2 Pints, | = | 1 Quart, | = | 57.75 |
| 4 Quarts, | = | 1 Gallon, | = | 231. |
| 63 Gallons, | = | 1 Hogshead, | = | 8.421 Cub. ft. |
| 2 Hogsheads | = | 1 Pipe, | = | 16.842 |
| 2 Pipes, | = | 1 Ton, | = | 33.684 |
| 10 Gallons, | = | 1 Anker, | = | 1.336 |
| 18 Gallons, | = | 1 Rundlet, | = | 2.405 |
| 31½ Gallons, | = | 1 Barrel, | = | 4.210 |
| 42 Gallons | = | 1 Tierce, | = | 5.614 |
| 2 Tierces | = | 1 Puncheon, | = | 11.228 |

#### 6. *Ale and Beer Measure.*

| | | | | |
|---|---|---|---|---|
| 2 Pints, | = | 1 Quart, | = | 70.5 Cub. in. |
| 4 Quarts, | = | 1 Gallon, | = | 282. |
| 8 Gallons, | = | 1 Firk. of ale, | = | 1.305 Cub. ft. |
| 9 Gallons, | = | 1 Do. beer, | = | 1.468 |
| 2 Firkins, | = | 1 Kelderk, | = | 2.937 |
| 2 Keld. | = | 1 Barrel, | = | 5.875 |
| 1½ Barrel | = | 1 Hogshead, | = | 8.812 |
| 2 Barrels | = | 1 Puncheon, | = | 10.750 |
| 2 Hogsheads, | = | 1 Butt, | = | 17.624 |
| 2 Butts, | = | 1 Ton, | = | 35.248 |

#### 7. *Dry Measure.*

| | | | | |
|---|---|---|---|---|
| 2 Pints | = | 1 Quart, | = | 67.2 Cub. in. |
| 4 Quarts, | = | 1 Gallon, | = | 268.8 |
| 2 Gallons, | = | 1 Peck, | = | 537.6 |
| 4 Pecks, | = | 1 Bushel, | = | 2150.42 |
| 8 Bushels, | = | 1 Quarter, | = | 17203.36 |

#### 8. *Coal Measure.*

| | | |
|---|---|---|
| 4 Pecks, | = | 1 Bushel. |
| 3 Bushels, | = | 1 Sack. |
| 3 Sacks, | = | 1 Vat. |
| 4 Vats, | = | 1 Chaldron. |
| 21 Chaldrons, | = | 1 Score. |
| 15 London Chaldrons, | = | 8 Newcastle chal. |

Measures.

### 9. *Troy Weight.*

| | | | | |
|---|---|---|---|---|
| 24 Grains, | = | | | 1 Pennyweight. |
| 20 Pennywt. | = | 1 Ounce, | = | 480 Grains. |
| 12 Ounces, | = | 1 Pound, | = | 5760 Grains. |

### 10. *Apothecaries Weight.*

| | | | | |
|---|---|---|---|---|
| 20 Grains Troy, | = | | | 1 Scruple. |
| 3 Scruples, | = | 1 Dram, | = | 60 Gr. Troy. |
| 8 Drams, | = | 1 Ounce | = | 480 |
| 12 Ounces | = | 1 Pound, | = | 5760 |

### 11. *Avoirdupois Weight.*

| | | | | |
|---|---|---|---|---|
| 16 Drams, | = | 1 Ounce, | = | 437.5 Gr. Troy |
| 16 Ounces, | = | 1 Pound, | = | 7000 |
| 28 Pounds, | = | 1 Quarter, | = | 196000 |
| 4 Quarters, | = | 1 Hund. wt. | = | 784000 |
| 20 Hund. wt. | = | 1 Ton, | = | 15680000 |

## II. FOR SCOTLAND.

### 1. *Linear Measure.*

| | | | | Eng. Inches. |
|---|---|---|---|---|
| 12 Inches, | = | 1 Foot, | | |
| 3 Feet, | = | 1 Ell, | = | 37.069 |
| 6 Ells, | = | 1 Fall, | = | 222.414 |
| 4 Falls, | = | 1 Chain, | = | 889.656 |
| 10 Chains, | = | 1 Furlong, | = | 8896.56 |
| 8 Furlongs, | = | 1 Mile, | = | 71172.48 |

### 2. *Square Measure.*

| | | | | Eng. Inches. |
|---|---|---|---|---|
| 9 Square ft. | = | 1 Square ell, | = | 1374110761 |
| 36 Sq. ells, | = | 1 Fall, | = | 49467.987396 |
| 40 Falls, | = | 1 Rood, | = | 1978719.49584 |
| 4 Roods, | = | 1 Acre, | = | 7914877.98336 |

### 3. *Liquid Measure.*

| | | | | |
|---|---|---|---|---|
| 4 Gills, | = | 1 Mutchkin, | = | 25.851 Cub. in. |
| 2 Mutchkins, | = | 1 Chopin, | = | 51.702 |
| 2 Chopins, | = | 1 Pint, | = | 103.404 |
| 2 Pints, | = | 1 Quart, | = | 206.808 |
| 4 Quarts, | = | 1 Gallon, | = | 827.232 |
| 8 Gallons, | = | 1 Barrel, | = | 6617.856 |

### 4. *Dry Measure.*

| | | | | Cubic inches for wheat, &c. | Cubic inches for barley, &c. |
|---|---|---|---|---|---|
| 4 Lippies, | = | 1 Peck, | = | 549.333 | 801.381 |
| 4 Pecks | = | 1 Firlot | = | 2197.333 | 3205.524 |
| 4 Firlots | = | 1 Boll | = | 8789.333 | 12822.126 |
| 16 Bolls | = | 1 Chald. | = | 140629.333 | 205154.016 |

### 5. *Scotch, Troy, or Dutch weight.*

| | | | | English Troy Grs. |
|---|---|---|---|---|
| 16 Drops, | = | 1 Ounce, | = | 476 |
| 16 Ounces, | = | 1 Pound, | = | 7616 |
| 16 Pounds, | = | 1 Stone, | = | 121856 |

## III. FOR IRELAND.

### 1. *Linear Measure,*

| | | |
|---|---|---|
| 12 Inches | = | 1 Foot. |
| 3 Feet | = | 1 Yard. |
| 7 Yards | = | 1 Perch. |
| 320 Perches | = | 1 Mile. |
| $54\frac{17}{18}$ Miles | = | 1 Degree. |
| 11 Irish miles | = | 14 Eng. miles. |

### 2. *Land Measure.*

| | | |
|---|---|---|
| $10\frac{2}{25}$ Inches | = | 1 Link. |
| 100 Links | = | 1 Chain. |
| 10 Square chains | = | 1 Acre. |
| 121 Irish acres | = | 196 English acres. |

Measures.

### 3. *Dry Measure.*

| | | | | |
|---|---|---|---|---|
| 2 Pints, | = | 1 Quart, | = | 54.4 |
| 4 Quarts, | = | 1 Gallon, | = | 217.6 |
| 2 Gallons, | = | 1 Peck, | = | 435.2 |
| 4 Pecks, | = | 1 Bushel, | = | 1740.8 |
| 2 Bushels, | = | 1 Strike, | = | 3481.6 |
| 4 Bushels, | = | 1 Barrel, | = | 6963.2 |
| 2 Barrels, | = | 1 Quarter, | = | 13926.4 |
| 4 Quarters, | = | 1 Chaldron, | = | 53705.6 |
| 5 Quarters, | = | 1 Wey, | = | 69632.0 |
| 2 Weys, | = | 1 Last, | = | 139264.0 |

### 4. *Liquid Measure.*

| | | | | |
|---|---|---|---|---|
| 4 Noggins, | = | 1 Pint, | = | 27.2 |
| 2 Pints, | = | 1 Quart, | = | 54.4 |
| 4 Quarts, | = | 1 Gallon, | = | 217.6 |
| 18 Gallons, | = | 1 Rundlet, | = | 3916.8 |
| 40 Gallons, | = | 1 Bar. ale, | = | 8704.0 |
| 42 Gallons, | = | 1 Tierce, | = | 9139.2 |
| 63 Gallons, | = | 1 Hogshd. | = | 13708.8 |
| 84 Gallons, | = | 1 Punch. | = | 18278.4 |
| $31\frac{1}{2}$ Gallons, | = | 1 Bar.wine | = | 6854.4 |
| 2 Hogsheads | = | 1 Pipe | = | 27417,6 |
| 2 Pipes | = | 1 Tun | = | 54835.2 |

## New FRENCH Weights and Measures.

### 1. *Linear Measure.*

| | | Eng. inch. | | | Eng. inch. |
|---|---|---|---|---|---|
| Millimetre, | = | .0393 | Decametre, | = | 393.708 |
| Centimetre, | = | .3937 | Hectometre, | = | 3937.08 |
| Decimetre, | = | 3.9370 | Kilometre, | = | 39370.8 |
| Metre, | = | 39.3708 | Myriametre, | = | 393708 |

### 2. *Square Measure.*

| | | Sq. feet. | | | Sq. feet. |
|---|---|---|---|---|---|
| Milliare | = | 1.076 | Are, | = | 1076.430 |
| Centiare, | = | 10.764 | Decare, | = | 10764,304 |
| Deciare, | = | 107.643 | Hectare, | = | 107643.048 |

### 3. *Solid Measure.*

| | | Cub. feet. | | | Cub. feet. |
|---|---|---|---|---|---|
| Millistere, | = | .035 | Decastere, | = | 353.166 |
| Centistere, | = | .353 | Hectostere, | = | 3531.660 |
| Decistere, | = | 3.531 | Kelostere, | = | 35316.607 |
| Stere, | = | 35.316 | Myriastere, | = | 353166.076 |

### 4. *Measures of Capacity.*

| | | Cub. inch. | | | Cub. inch. |
|---|---|---|---|---|---|
| Millilitre, | = | .061 | Decalitre | = | 610.270 |
| Centilitre, | = | .610 | Hectolitre, | = | 61027.098 |
| Decilitre, | = | 6.102 | Kilolitre | = | 61027.098 |
| Litre | = | 61.027 | Myrialitre | = | 61027.098 |

### 5. *Measures of Weight.*

| | | | | | |
|---|---|---|---|---|---|
| Milligramme, | = | .015 | Decagramme, | = | 154.33 |
| Centigramme, | = | .154 | Hectogramme, | = | 1543.3 |
| Decigramme, | = | 1.543 | Kilogramme, | = | 15433 |
| Gramme, | = | 15.433 | Myriagramme, | = | 154330 |

### *Measure of Time.*

| | | |
|---|---|---|
| 100 Seconds, | = | 1 Minute. |
| 100 Minutes, | = | 1 Hour. |
| 10 Hours, | = | 1 Day. |

*Division of the Circle.*

| | | |
|---|---|---|
| 100 Seconds, | = | 1 Minute |
| 100 Minutes | = | 1 Degree. |
| 400 Degrees | = | Circum. of the circle. |

*Modern Weights and Measures of different Nations, according to Cavallo, &c.*

| | Eng. | | |
|---|---|---|---|
| Amst. ft. | = .930 Cavallo, | Pd. | = 7636. V. Eng. gr. |
| Antw. — | = .940 Hutton, | — | = 7048 H. |
| Berlin,— | = .992 H. | — | = 7230 Eytelwein. |
| Bern, — | = .962 Howard, | — | = 6722 |
| Brabt. ell, | = 2.268 Vega, | — | = 7249 Coquebert. |
| Bruss. ft. | = .902 H. | — | = 7201 V. |
| China, math.ft. | =1.127 H. | Kin. | = 9223 H. |
| China, imp. ft. | =1·051 H. | — | = 5802 Coquebert. |
| Constan. f. | =1.165 H. | Pd. | = 7578 H. |
| Copenh. | =1.049 H. | — | = 6941 H. |
| Cracow | =1.169 H. V. | — | = 6252 H. |
| Dantzick | = .923 H. | — | = 6574 H. |
| Dresden | = .929 Wolfe, | — | = 7210 V. |
| Florence | = .995 H. | — | = 5287 H. |
| Hamburg | = .933 H. | — | = 7315 H. |
| Leghorn | = .992 H. | — | = 5146 H. |
| Lisbon | = .952 H. | — | = 7005 H. |
| Madrid | = .915 H. | — | = 6544 H. |
| Nap.palm | = .861 H. | — | = 4952 H. |
| Paris ft. | =1.066 H. | — | = 7561 H. |
| Riga | = .933 H. | — | = 6149 H. |
| Stock. | =1.073 H. | — | = 9211 H. |
| Strasbg. | = .969 H. | — | = 7277 H. |
| Venice | =1.140 Bernard | | = 6827 H. |
| Vienna | =1.037 How. C. V. | | = 8648 V. |

*Ancient Weights and Measures of different Nations, according to Hutton, &c.*

| | | |
|---|---|---|
| Arabian foot | = | 1.095 Eng. H. |
| Babylonian | = | 1.135 H. |
| Egyptian | = | 1.421 H. |
| Greek | = | 1.007 C. |
| Hebrew | = | 1.212 H. |
| Hebrew cubit | = | 1.817 H. |
| Hebrew sacred cubit | = | 2.002 H. |
| Hebrew great cubit | = | 6 Common H. |
| Macedonian foot | = | 1.160 H. |
| Ptolemaic | = | 1.007 H. |
| Roman foot | = | .967 Pecard, &c. |
| Sicilian foot of Archimedes | = | .730 |

*Greek Weights in English Grains.*

| | | |
|---|---|---|
| Attic obolus | = | 9.1 Arbuthnot. |
| Attic drachma | = | 54.6. A. |
| Attic greater mina | = | 5464. A. |
| Attic talent | = | 60 minae. |

*Roman Weights in English Grains.*

| | | |
|---|---|---|
| Denarius | = | 62.5. A. |
| Ounce | = | 437.2. A. |
| Pound of 12 ounces | = | 5246. A. |
| Egyptian mina | = | 8326. A. |
| Ptolemaic mina | = | 8985. A. |
| Alexandrian mina | = | 99.92. A. |

**MEATH**, a maritime county of Ireland, bounded on the north by Cavan and Louth, on the east by the Irish channel and the county of Dublin, on the south by Kildare, and on the west by Longford and Westmeath; is about 35 miles in length and 29 miles in breadth, and contains an area of 327,900 acres. This county is but little diversified, and consists chiefly of rich pasture lands. The Boyne, which is the principal river, is navigable for large vessels as far as Drogheda. In its course, which extends about 50 miles, it is augmented by the Athboy, the Blackwater, the Mannoch, and other rivers, and its banks have a pleasing aspect. Meath contains numerous plantations, a considerable limestone quarry at Ardbraccan, together with a valuable bed of copper at Walter's Town. Some of the estates are very extensive, and arable farms run from 100 to 200 acres. This county is chiefly remarkable for grazing; and besides bullocks and sheep, an extraordinary quantity of cows are fattened by the farmers, but the breed of horses is inferior. Agriculture is in a promising state, and the crops consist chiefly of barley, oats, rye, clover, flax, and potatoes.

The principal manufactures are sacking, dowlas, and coarse linen, together with straw bonnets, paper, and cotton. The inhabitants, which are mostly catholics, were in 1792, estimated at 112,400. The chief towns of Meath are, Trim the county town, Navan, and Kells. The mount at New Grange, discovered in 1699, is one of the most remarkable antiquities of Meath. Its exterior appearance is that of a tumuli, but within is an antique subterraneous temple.

MEATH, West, a county in the province of Leinster in Ireland, is bounded on the north by Cavan, on the east by Meath, on the south by King's county, and on the west by Roscommon, which separates it from the river Shannon. It is well watered, and fertile in pasturage and corn, and contains a population of 70,000. The county town is Mullingar.

MECCA, the capital of Arabia Felix, well known as the birth place of Mahomet, is situated in a sterile valley, and is about two miles in length and one mile in breadth. It contains some handsome streets; and, among the public buildings, the principal object is the Caaba or temple, already described in the order of the alphabet. The heat of summer at Mecca obliges the inhabitants to shut their windows and water the streets. The government of the city is vested in a sheriff or temporal prince, who enjoys a considerable revenue. Of the sanctity of Mecca, the Mahometans have a very high opinion. The support of the place arises chiefly from the intercourse with pilgrims. Mecca with its suburbs has now very much declined, and the population is reduced to about 18,000; whereas at one period it was in a most flourishing condition, and contained no less than 100,000 inhabitants. Mecca suffered severely in 1803 from the destructive zeal of the Wahabites, a warlike sect, so called from their founder Abdul-wehab. These wild fanatics overran the country and committed the most barbarous outrages, till in 1813 they were happily repulsed by the pashaw of Egypt.

# MECHANICS.

Extent of the Science.

The term Mechanics is derived from Μηχανη, a machine. In modern acceptation, the word is of wide import. It is used to signify that branch of natural science which treats of the properties and laws of matter and motion, and which has not improperly been called the geometry of motion.

The science of mechanics has, by Sir Isaac Newton, been divided into *rational* or *theoretical* and *practical*. By *rational* or *theoretical* mechanics, is meant the whole theory of motion; it shews how to determine the motion produced by given powers or forces; and conversely, when the phenomena of the motions are given, how to trace the powers or forces from which they arise. *Practical* mechanics treat of the different mechanical powers, and of their modifications and combinations; in other words, of simple and compound machines.

## Part I. Rational or Theoretical Mechanics.

In this branch of our subject we shall treat of the following topics:—1. The properties of matter. 2. The laws and measures of motion. 3. The motion of bodies uniformly accelerated and retarded. 4. The equilibrium of fluids. 5. The motion of fluids.

### Sect. I. *Properties of Matter.*

Matter, body, or substance, is extended in the three dimensions of space; in other words, has length, breadth, and thickness, is impenetrable, and moveable. To these inherent properties of matter, philosophers have added the general ones of *inactivity*, *divisibility*, *elasticity*, and *porosity*; as also, *figurability*, *refractibility*, *condensibility*, *compressibility*, and *dilatability*.

According to the idea of Sir Isaac Newton, which was first fully developed by Father Boscovich, in his *Theoria Phil. Nat.*, published at Vienna in 1759, every body is made up of a number of separate and indivisible *physical points* or *atoms*, which act on each other with forces which are attractive or repulsive according to their relative situations. At all considerable or *sensible* distances, the force is attractive, and acts inversely as the squares of the distances of the particles of bodies from each other. This is what is called the *attraction of gravitation*. In the small and *insensible* distances within which the sensation of touch takes place, and which do not exceed a very small fraction of an inch, there are many alternations of attraction and repulsion among the elements of body, according to the distance which their respective situations bear to each other. Consequently, within this narrow limit, there are points of quiescence, in which the particles neither attract nor repel. The force exerted between two particles, when their distance is infinitely small, and just on the point of vanishing, is an insuperable repulsion; so that no force, however great, can bring two particles into actual contact, or cause them to coalesce.

Rational Mechanics.

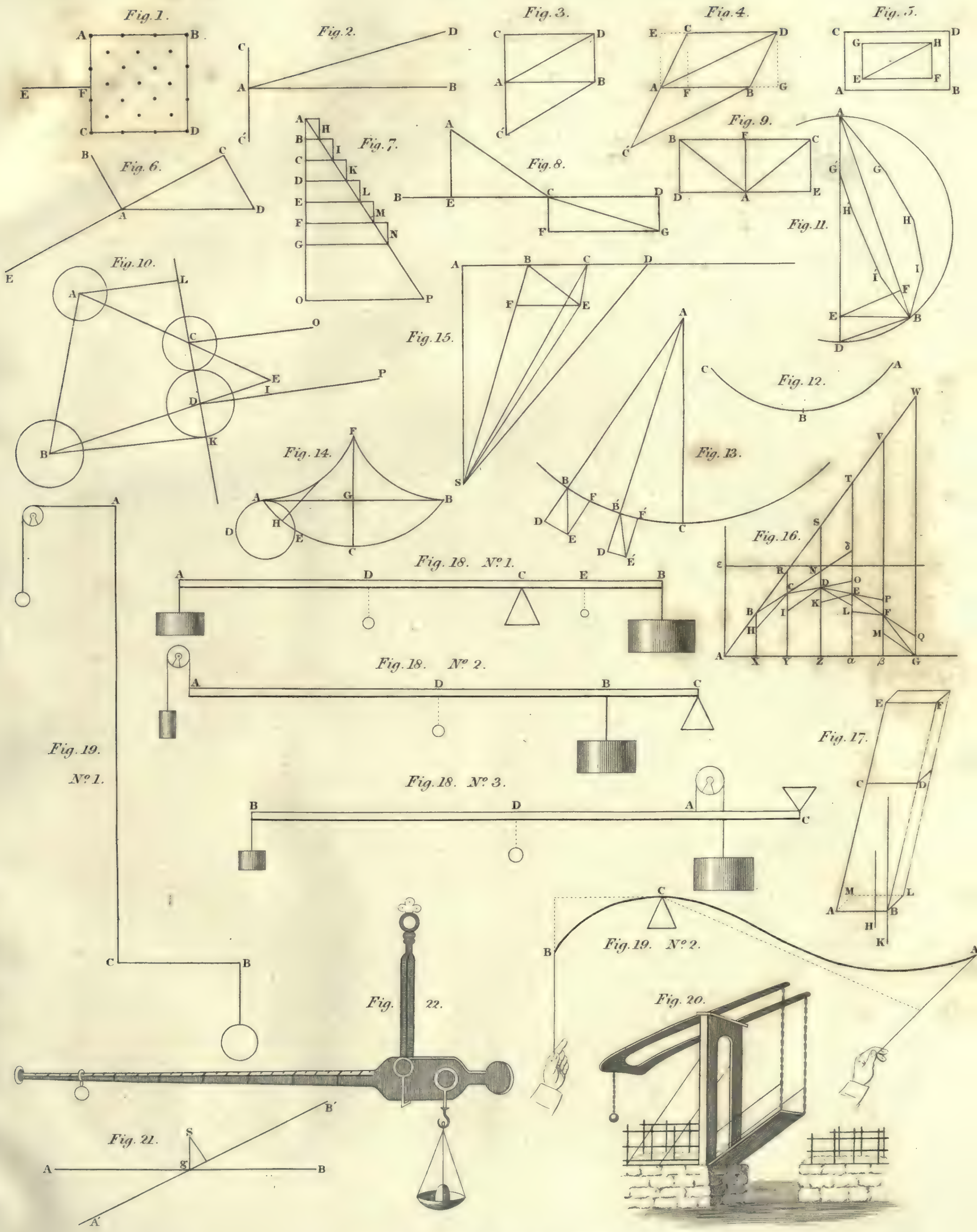
On this hypothesis, commonly called the *atomic theory*, philosophers have undertaken to explain the various appearances which matter assumes, as solidity, fluidity, vapours; as also, solution, precipitation, crystallization, and all the phenomena of chemical agency. We are concerned with it only in as far as it accounts for mechanical action.

To understand how a substance made up of a number of particles, such as we have supposed, would act and be acted on, let us imagine ABCD, Fig. 1. Plate 119, to represent part of the superficies of a body. Unless some external force act on the body, the atoms will remain in their points of quiescence. If they are packed closer together in the direction EF, the repulsive force which exists among them will resist the pressure, and this resistance will be greater the closer they are brought to each other. On the contrary, if these particles are drawn away farther from each other, in the direction FE, the attractive force which exists among them will cause them to resist the separation, and this resistance to separation will, to a certain point, be greater the farther the particles or atoms are drawn from each other. We shall have a correct idea of the mutual action of these particles, if we suppose them connected together by means of a number of spiral springs. If some external force do not act on the springs, they remain quiescent. If compressed, they react, and, if not overstrained, their reaction is proportional to the compressing force. On the contrary, they resist any force which tends to produce dilation with forces which are also proportional.

Such a constitution of things evidently implies an elasticity in bodies which is perfect. And the experiments of M. Coulomb on torsion tend to prove that all bodies are possessed of a perfect elasticity within certain limits. He found that when he had suspended a wire 20 inches long, with a ball or cylinder carrying an index to the bottom of it, if he gave the wire ten twists, the index returned to its original position in a certain period. If he gave it any less number of twists, it returned in about the same time. But if he gave it eleven turns, it did not come back to its original position by nearly a whole revolution. The constituent particles of the wire had taken up a new position in relation to each other. Still, however, the wire retained its original elasticity. If subjected to ten turns, as before, after its oscillations were finished, the index rested again in the position from which it had been taken. Other substances, when subjected to the same experiment, give similar results. Dr Robison found that a thread of fine clay, (one of the least elastic substances known,) eleven feet long, and $\frac{1}{15}$ of an inch in diameter, took $5\frac{1}{2}$ turns any given number of times, and always recovered its first position. When he gave it seven turns, it took a *set*; but still, if he gave it $5\frac{1}{2}$ twists, it took no new set, but within this limit was perfectly elastic as formerly. When he had given it ten turns in addition to the first seven, and in the same direction, he still found that it returned $5\frac{1}{2}$

# MECHANICS

## PLATE 119.



Drawn & Engraved by W.H. Lizars, for the Encyclopædia Edinensis.

times as before. The idea of a body being elastic, if its constituent particles were in contact, even if it were only in single points, is very difficult to conceive.

*Contact and impulse.*—If the hand be applied to a body made up of such elementary parts as we have supposed, the resisting force possessed by them, which commences probably about the distance of the 8000th part of an inch, and extends within the 89,000th, excites in us the sensation of feeling. If a blow be impressed on such a body, free to move, this same repulsive force will cause it to proceed onward, the motion lost by the impinging body being, as it were, communicated or imparted to the body struck. The passage of light through glass, the fact that marble takes in oil, that gold and silver imbibe mercury, and that different liquids decrease in volume when mixed in certain proportions, (as for instance, if two parts of water be mixed with one of spirit of wine, the bulk of the compound will be $\frac{1}{20}$ less than the sum of the bulks of the fluids when separate, (and other instances of the same kind mentioned by Muschenbroek, § 91. No. 4.,) prove that although the elementary parts of matter may touch in some points, there are at least many pores disseminated through bodies. But besides the elasticity of bodies, their contracting by cold, and expanding by heat, in all their dimensions of length, breadth, and thickness, appears to be a decisive proof that their particles are not in contact at all. The circumstance that fluids retain their fluidity under any degree of pressure, seems to afford ground for a demonstration that their particles cannot be in mathematical contact.

Air has often been compressed into one-half its ordinary bulk, but it has never been observed that it was less fluid in this condition than in its usual state. But if we suppose its particles to be spherical, and to touch only in one point, by such a compression, they must have been reduced nearly to cubes touching each other on all their six sides. In such a condition, fluidity never could exist.

Water, and what are commonly called non-elastic fluids, (though not strictly so,) have never been compressed into half their bulk; but they have suffered so much compression, that they must have ceased to be fluid, if their particles had been in contact at all; for they must have been flattened on every side by the condensation to which they were subjected.

Various arrangements of the constituent particles in different bodies, seems quite competent to account for all the diversity in the phenomena of solid and liquid cohesion, as hardness, softness, ductility, viscidity, &c. If a body be made up of particles of which the action is the same in every direction, it will evidently be of the nature of a perfect fluid, the situation of any particle among the rest being quite indifferent. If the action of the atoms be greater in one part than another, they will not rest indifferently in every position, but will have a tendency to one point rather than to another, and indicate a kind of polarity, like small magnets floating on the surface of quick-silver. Perfect fluidity, as taking place only in consequence of a certain determinate arrangement of the elementary parts, our theory would lead us to expect to be of comparatively rare occurrence; as also, since the possible arrangement of them exceeds all numeration, the varieties of firm, soft, and viscid cohesion, to be very great; and this, accordingly, we find to be the case in nature.

*Intervals of atomic action.*—Some of the minute intervals of atomic action have been ascertained with considerable accuracy. Thus, if the surface of a very finely polished mirror, (such, for instance, as are made by the first artists for the best Hadley's quadrants,) be applied to the surface of another equally fine, attraction will take place, and this, (though in an inferior degree,) even if they be separated by a fibre of silk wound about one of them. This instance is by no means the only one in which attraction of this kind occurs. In making specula for reflecting telescopes, the *tools* are often so closely ground together, that the one will lift the other, although it weigh two pounds. If two small pieces of lead be scraped clean, and pressed together with a slight twist, they will cohere so strongly as to require a much greater force than their own gravity to separate them. A smart blow will make them cohere equally well with the pressure and twist. The same is said to hold of two pieces of gold; and it is on this principle that metals are gilded. Silk fibres are flat; the shorter diameter is about the 2400th part of an inch. The experiment does not succeed if the distance between the plates be much greater than this, that is to say, unless it be the flat side of the fibre which is interposed between them. Dr Robison concluded, from some very accurate optical experiments, that physical contact, or the feeling of pressure, takes place at about the distance of the 5000th part of an inch nearly. He also argues, from some experiments made by Sir Isaac Newton, that the repulsive force which occasions the sensation of contact or pressure, still exists at the minute interval of the 89,000th part of an inch. It is exceedingly likely, that between the distances at which the glass plates attract each other, and that where physical contact or pressure takes place, there is a point of quiescence, or situation in which bodies neither attract nor repel. From the optical appearances exhibited by a fluid ascending by capillary attraction between two plates of glass, it is rendered extremely probable that the attraction here takes place nearer than the 89,000th part of an inch. (See Dr Robison's *Mech. Phil.* Vol. I. Art. Corpuscular Action.

*Capillary attraction*, is the name given to the force which causes a fluid to rise in a tube of which the diameter does not exceed $\frac{1}{10}$ of an inch. It is this power which occasions a piece of sugar to imbibe water, a sponge to suck in moisture, &c. &c. It is, no doubt, also instrumental in causing sap to ascend in plants. But, perhaps, the best illustration of this subject is to be had by the experiment alluded to above, viz. by taking two rectangular or square pieces of glass, and joining two of the edges, the opposite two being at the same time kept separate, by a piece of wax, or otherwise. If, then, they be immersed in a bason of water about an inch, a most beautiful hyperbole will be formed by the rising of the water between them. Its assymptotes will be the common section of the planes and a line parallel to the water.

It may be inferred, from the continuity of gold in the manufacture of gold lace, that the distance at which the attraction of cohesion among the particles of bodies takes place does not exceed perhaps the millionth of the millionth of an inch. In this manufacture, silver wire is covered with a certain quantity of gold leaf, and then drawn out very fine. Here we have certain data for concluding, that the gold does not exceed the fourteen millionth part of an inch in thickness, yet it is so continuous that no deficiencies can be observed in it, even by the most powerful microscopes, and it defends the silver from the action of nitrous acid.

On this subject see Dr Robison, *ubi supra*,—Boscovich, *Theoria Phil. Nat.* &c. &c.

### Sect. II.—*Of Motion,—its Measures and Laws.*

The idea of motion involves both those of *space* and *time*.

*Space* has extension without limits; is immoveable, uniform, and similar in all its parts, and without resistance. It consists of parts, which admit of division without end, but inseparable, and incapable of having their places or distances altered.

*Motion* is a property of body, and may be defined a continued change of place; in other words, it is the change of that part of space which the body occupies, or in which it is extended. Motion is absolute and relative. The motion of a body is absolute when it changes its situation in *absolute* space; relative, when it changes its place in relation to surrounding bodies. It is said to be apparent when a body changes its place with regard to bodies which appear to be at rest.

If two bodies move in the same or parallel straight lines to the same side, and with equal velocities, they have no motion relatively to each other. If they move in the same or parallel straight lines, but in opposite directions, their relative motion is equal to the sum of their real motions; if in the same direction with different velocities, it is equal to the difference of their real motions.

Bodies are often *apparently* in motion, though really at rest, and really in motion, though they seem to be at rest. Thus, a person sailing on a river thinks that he himself is at rest, and that the objects on the banks are moving away from him. Thus, also, the heavenly bodies, though really at rest, seem to revolve about the earth, and the earth seems standing still, though revolving on its axis, and also advancing in its orbit with great rapidity.

*Time* we conceive to be a quantity increasing or flowing uniformly, and consisting of parts capable of being compared with each other.

When considered without regard to measurement or comparison of its parts, time is said to be absolute. When subjected to measurement or reckoning, it is said to be relative.

A body is said to move uniformly when the spaces it describes in equal time are equal to each other. It is obvious, that the space moved over by a body proceeding with an uniform velocity, will be had by multiplying the time into the velocity; in other words, by multiplying the number of seconds the motion has continued by the space passed over in one second; or, making use of symbols,—S representing the space passed over, V the velocity, T the time; $S = V \times T$ consequently $V = \frac{S}{T}$ and $T = \frac{S}{V}$. In these expressions, T is denoted by seconds, S and V in some known measure of length.

*Momenta of bodies.*—The momenta of bodies, or their quantities of motion, are estimated by their masses or quantities of matter multiplied by their velocities. And hence, if two bodies move with velocities which are inversely as their quantities of matter, their momenta are equal. That is, if B and B′ be the two bodies, V and V′ their respective velocities, and if B be to B′ as V′ is to V, $B \times V$ will be equal to $B' \times V'$. This simple principle, which is, indeed, the foundation of all mechanics, affords us a very easy way of estimating the power of any engine, simple or compound. We have merely to ascertain with how much greater velocity the power moves than the weight; and (abstracting from the resistance occasioned by friction, &c.,) we are certain, that by so much the power is increased by means of the engine. This principle may also be inferred from the fourth Prop. of the section, *q. v.*

### *Laws of Motion.*

A body always perseveres in a state of rest or of uniform rectilineal motion, unless disturbed by some external influence. This law appears to follow immediately from the nature of matter, which is incapable of determining itself to one state more than another. The distinctive character of mind is spontaneous action; of matter, deadness or inertion. If a body be situated in any part of free space, and nothing draw or impel it in any way, it must remain for ever in that part of space; and if it receive an impulse in any direction, it will go on for ever in that direction, describing equal spaces in equal times, for it cannot, of itself, deviate from a straight line, or change its velocity.

A perpetual motion, like the *quadrature* of the circle of the mathematicians, and the philosopher's stone of the chemists, has been a problem which many have sought in vain to solve.

The idea, however, of constructing a machine which shall move perpetually without the occasional renewal of the force by which it is put in motion, seems to arise out of an ignorance of the principles of mechanics; and the impossibility of such a thing ever being accomplished, seems almost to admit of demonstration. It implies, that an event be alternately an effect and a cause, and that an effect be greater than its cause. If one weight, for instance, be made to raise another, it can only, even granting that friction and resistance of all kinds were removed, be elevated to a height which is inversely as its gravity.

For some of the most ingenious contrivances which have been tried to produce a perpetual motion, see Hutton's *Mathematical Recreations*, Vol. II. p. 102.

It is no objection to this law, that the motions which we produce among bodies here soon come to an end. This is caused by the resistance of the air, friction, &c. There are many phenomena which tend to its confirmation. If a body be let fall from the top of a mast of a ship when in motion, it will fall at the foot of the mast, although, in the meantime, the ship may have advanced many feet in her course. If a man be seated in a carriage, and it move suddenly forward, he will strike against the back of it, his *inertia*, or tendency to remain at rest, having caused him to be left behind. In the same way, if the carriage be suddenly stopped, he will be precipitated forward, his *inertia*, or tendency to continue in motion, carrying him onward. And so in many instances.

From this law of motion, it is inferred as a corollary, that if a body move in a curve, it is under the continued influence of external action; and that, if this influence were to cease at any point, the body would go on in a straight line, which would be a tangent to the curvilinear path at that point.

2. The action and reaction of bodies are equal, and in opposite directions. Body not only naturally perseveres in the same state, but, by its own *inertia*, resists every influence which has a tendency to produce an alteration on that state. When two bodies meet, each endeavours to remain in its own state, and resists any change; and, since the change produced on any of the bodies may be measured by the force with which it acts on the other, or by the resistance it meets with, the changes produced in the motions of each will be equal, but in opposite directions. The one does not acquire any new force but what the other loses in the same direction, and *vice versa*. Hence, although, by the impulse, motion may pass from the one to the other, the sum of the motions yet remains the same, estimated in a given direction, and is unchangeable by their mutual action on each other. See Maclaurin's *Account of Sir Isaac Newton's Discoveries*, Book II. Chap. ii. Sect. 4.

3. What we have denominated the second law of motion is usually reckoned the third; and this, because what is commonly called the third, viz. *that motion communicated is always in the direction of the force impressed*, may be inferred by a simple induction from the first, it being understood that force, or the cause of motion, is always measured by the effect, or by the motion it produces in a given time. Thus,[*] " let a body at A, Fig. 2. Pl. 119. be acted on by two forces at the same instant, one of which acting alone would cause it to move uniformly over A B in a given time; and the other acting alone would cause it to move over A C at right angles to A B in the same time. The velocity of the body in one of these directions will not be changed by the force impelling it in the other.

" For, if the motion of A in the direction A B is accelerated by the force A C, it would, for the same reason, be retarded by a force acting in the opposite direction A C′; for A C and A C′ are alike situated in respect of A. Now this is absurd. Therefore," &c.

### *Composition of Forces.*

Prop. I.—If a body be acted on by two forces at the same time, it will describe the diagonal of a parallelogram under these two lines, in the time in which it would describe either of its sides by those forces acting separately.

This proposition comprehends two cases: 1st, When the forces are at right angles; 2d, When they are oblique to each other.

Case 1st.—When the forces are at right angles.

Let the body A, Fig. 3. Pl. 119. have a motion impressed on it in the direction A B, and with a force represented by the line A B. At the same time, let another motion be communicated to it in the direction A C, and with a force represented by the line A C. Complete the parallelogram A B D C, and draw the diagonal A D; this is the direction in which the body will move, and it will arrive at D in the time in which it would have described A B by the first mentioned motion, and A C by the second. A C being parallel to B D, the motion in the direction AC has, by our inference from the laws of motion, no effect in promoting or retarding the approach of A towards B D; consequently it will arrive at B D in the same time as if the first mentioned motion A B only had been impressed on it. The same thing may, in like manner, be proved of A C and C D. Therefore, the body A must arrive at both lines, C D and B D, in the time in which it would have described A B by the first motion and A C by the second. But this can be brought about in no other way than by its coming at their intersection D. It must, therefore, describe the diagonal A D, and that in the time in which it would have described the simple motions A C or A B.

Case 2d.—When the forces are oblique to each other.

*The following demonstration is that which the late Professor Playfair used to give in his class*:—

Let the lines A C and A B, Fig. 4. Pl. 119, represent the spaces over which a body acted on separately by the two forces would move in the same time, be placed at a given angle C A B, the line which the body will describe in that time, when both forces act on it at once, is A D, the diagonal of the parallelogram under A C and A B. For, from A raise the perpendicular A E, and from C and D let fall the perpendicular C F and D G. It is evident that E A G D is a rectangle, and that A D is its diagonal. By the first case it is clear, that the force A D is equal to the forces A E and A G. But A E and A G are equal to A C and A B; for, by our first case, A C is equal to A E and A F, and F G, the remainder of A G, is equal to A B; and, therefore, A E, A F, and F G, or A E and A G, are equal to A C and A B, *i. e.* = A D.

We shall have a very good illustration of this proposition, which is commonly known under the name of the *composition of forces*, or *composition of motion*, if we suppose A B D C (Fig. 5. Pl. 119.) a ship, and that, in the time in which she shall have proceeded in her course over the space E F, a man on her deck shall have walked from E to G. To the people in the ship he will appear to have passed this space only, but he will really be in H, having been carried by the motion of the ship to F H, and having moved in the diagonal E H of the parallelogram G E F H.

### *Resolution of Forces.*

Prop. II.—The force A D, (Fig. 3. and 4. Pl. 119.) in the direction of the diagonal of the parallelogram

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[*] Playfair's *Outlines*, Vol. I. p. 28.

A B D C, and proportional to it, may be resolved into forces A C and A B, in the direction of the sides of the parallelogram, and proportional to them.

For if A C′ be taken equal to A C, and in an opposite direction, and the parallelogram A C′ B D completed, A B will be the diagonal of this parallelogram; and, by our last proposition, it is equal to the forces A C′ and A D. That is to say, if, from the force A D we take away A C (= A C′) the side of a parallelogram of which it is the diagonal, there will remain a force equal to A B, the other side of the parallelogram. Therefore a force, &c.

This proposition is known by the name of the *resolution of forces*, and, together with the preceding, of which it is the converse, is of the greatest use in mechanics.

Prop. III.—If three forces, B A, D A, and E A, (Fig. 6. Pl. 119.) which act on a body A at the same time, be equal to C D, A C, and A D, the sides of the triangle A C D, and also either parallel to them or in the same direction with them, so that the angle contained by any two of the forces is the supplement of the angle contained by the corresponding sides of the triangle, the forces will be in *equilibrio.*

For from A let A B be drawn parallel and equal to D C, and A C produced till A E be equal to it. From the property of parallel and diverging lines, B A D is evidently the supplement of C D A; D A E is also the supplement of B A C, which is equal to A C D. A C is evidently the diagonal of a parallelogram under A D and D C, or A D and A B, and is therefore equal to the forces represented by these lines; but it is also equal to A E. Therefore, if three forces, &c.

It may be proved in a similar manner, that if any number of forces be parallel and proportional to the sides of a polygon, they will be in *equilibrio.*

### *Collision of Bodies.*

Prop. IV.—If a body perfectly hard or perfectly soft, (*i. e.* non-elastic,) strike another of the same nature directly, their velocity after collision will be equal to the sum of the momenta of the bodies before collision divided the sum of their quantities of matter.

For, calling the bodies A and B; their velocities $a$ and $b$; and supposing the one to overtake the other, at collision the momentum of A will be $A\,a$, and of B, $B\,b$; wherefore $(A+B)\,V = A\,a + B\,b$ and $V = \frac{A\,a + B\,b}{A+B}$

When the bodies meet, $b$ becomes negative; so that the velocity after impact is $\frac{A\,a - B\,b}{A+B}$: If the velocities of the bodies are inversely as their quantities of matter, their momenta will be equal, according to the fundamental theorem given in the beginning of this section, or $A\,a = B\,b$, and consequently $V = 0$. When $b = o$, that is, if B is at rest $V = \frac{A\,a}{A+B}$, if one of the bodies be immoveable, it may be regarded as infinite when compared with the other, and thus V becomes equal to 0, for in that case the denominator $A + B$ of the fraction is infinite.

*Velocity and momentum.*—If one of the bodies A overtake the other B, the velocity which it losses will be equal to $a - \frac{A\,a + B\,b}{A+b}$ which, reduced to a fraction, is equal to $\frac{B\,a - B\,b}{A+b} = \frac{B\,(a-b)}{A+B}$. The quantity of motion, or the momentum lost by it, will be equal to this lost velocity multiplied into the quantity of matter contained in the body, or $\frac{A\,B\,(a-b)}{A+b}$. It may be proved in the same way, that the velocity gained by B is equal $\frac{A\,(a-b)}{A+B}$; and that, conformably to the *law of the equality of action and reaction,* the quantity of motion gained by it is equal to $\frac{A\,B\,(a-b)}{A+B}$ the same that was lost by A. When the bodies meet, the velocities lost or gained, are $\frac{B\,(a+b)}{A+B}$ and $\frac{A\,(a+b)}{A+B}$ and the momenta $\frac{A\,B\,(a+b)}{A+B}$.

Prop. V.—To determine the path after collision of two perfectly hard or perfectly soft bodies, moving at a given angle before collision.

Let A C, Fig. 8. Pl. 119, represent the direction and velocity of A before collision, and B C the direction and velocity of B. Let fall from A, A E, perpendicular, upon B C, E C will represent the velocity of A along B C; make C D equal to $\frac{(B \times B\,C) + (A \times E\,C)}{A+B}$ and at right angles to B C, and make $C\,F = \frac{A \times A\,E}{A+B}$; then, from the construction C G, the diagonal of the rectangle under C F and C D will represent the common direction and velocity of A and B after collision.

*Definition.*—A body is said to be perfectly elastic if, when its form is altered by pressure or collision, it exerts a force in restoring it equal to that by which the change was produced.

### *Collision of Elastic Bodies.*

Prop. VI.—If a perfectly elastic body impinge on another moving in the same direction, its velocity after the stroke will be expressed by the formula $\frac{A\,a - B\,a + 2\,B\,b}{A+B}$ A and B denoting as above the bodies, and $a$ and $b$ their respective velocities before *collision.*

If A and B were hard, the loss of velocity which A would sustain would be $\frac{B\,(a-b)}{A+B}$; but since they are elastic, the impinging body must lose twice as much of its velocity as if they were hard, and the body struck gain twice as much. For the body A not only loses a quantity of velocity equal to what it would have parted with if it had struck upon a hard body, but as much more additional by the body B recovering its figure; and B gains twice as much velocity as if it had been struck by a hard body, by A recovering its figure. The velocity of A, therefore, after contact, will be equal $a - \frac{2\,B\,(a-b)}{A+B}$

which, reduced to a fraction, is equal to $\frac{\mathrm{A}\,a+\mathrm{B}\,a-2\,\mathrm{B}\,a+2\,\mathrm{B}\,b}{\mathrm{A}+\mathrm{B}}=\frac{\mathrm{A}\,a-\mathrm{B}\,a+2\,\mathrm{B}\,b}{\mathrm{A}+\mathrm{B}}$

In the same way it may be shewn that the velocity of B after the stroke is $\frac{2\,\mathrm{A}\,a-\mathrm{A}\,b+\mathrm{B}\,b,}{\mathrm{A}+\mathrm{B}}$ or $\frac{\mathrm{B}\,b-\mathrm{A}\,\mathrm{B}+2\,\mathrm{A}\,a}{\mathrm{A}+\mathrm{B}}$. When the bodies are equal they interchange velocity, for the formula $\frac{a-\mathrm{B}\,a+2\,\mathrm{B}\,b}{\mathrm{A}+\mathrm{B}}$ then becomes $\frac{\mathrm{B}\,a-\mathrm{B}\,a+2\,\mathrm{B}\,b}{\mathrm{A}+\mathrm{B}}$ $=\frac{2\,\mathrm{B}\,b}{2\,\mathrm{B}}=b$, and the velocity of B likewise $=a$.

If the bodies move in opposition directions, one of the velocities, $b$, becomes negative.

Prop. VII.—The relative velocity of two elastic bodies is the same before and after collision, only the body which had the least velocity before collision has the greatest after it.

Supposing the velocity of the two bodies A and B, before collision, to be $a$ and $b$, and their velocity after it $a'$ and $b'$, the velocity $b'$, by our last proposition, is equal to $\frac{\mathrm{B}b-\mathrm{A}b+2\mathrm{A}a,}{\mathrm{A}+\mathrm{B}}$ and $a'=\frac{\mathrm{A}a-\mathrm{B}a+2\mathrm{B}b,}{\mathrm{A}+\mathrm{B}}$ their difference $=\frac{\mathrm{B}b-\mathrm{A}b+2\,\mathrm{A}a-\mathrm{A}a+2\,\mathrm{B}a=2\,\mathrm{B}b}{\mathrm{A}+\mathrm{B}}$ $=\frac{\mathrm{A}\,a-\mathrm{A}\,b+\mathrm{B}\,a+\mathrm{B}\,b}{\mathrm{A}+\mathrm{B}}=\frac{\mathrm{A}\,(a-b)+\mathrm{B}\,(a-b)}{\mathrm{A}+\mathrm{B}}$ $=\frac{\mathrm{A}+\mathrm{B}\,(a-b)}{\mathrm{A}+\mathrm{B}}=a-b$. So that the difference after collision is equal to the difference before it, or $a-b=b'-a'$.

Hence $a+a'=b+b'$.

Prop. VIII.—If a perfectly elastic body strike another of the same nature directly, the sum of the products obtained by multiplying each of the bodies into the square of its velocity is the same after collision that it was before it.

For, since by our second law of motion, viz. That the action and reaction of bodies on each other are equal, the quantities of motion are the same before and after impact; $\mathrm{A}\,a+\mathrm{B}\,b=\mathrm{A}\,a'+\mathrm{B}\,b'$, or $\mathrm{A}\,(a-a')=\mathrm{B}\,(b'-b)$; and since, by our last proposition, $a+a'=b'+b$; by multiplication $\mathrm{A}\,(a^2-a'^2)=\mathrm{B}(b'^2-b^2)=\mathrm{A}a^2-\mathrm{A}a'^2=\mathrm{B}b^2-\mathrm{B}b'^2$, and consequently by transportation $\mathrm{A}a^2+\mathrm{B}b^2=\mathrm{A}a'^2+\mathrm{B}b'^2$.

This proposition is known by the name of the *conservation of active forces.*

Prop. IX.—To determine the path of an elastic body striking obliquely against an immoveable plane.

If a body, B, (Fig. 9. Pl. 119.) strike a plane, D E, at a given angle, B A D, it will be reflected from it in a direction A C, making an angle C A E equal to B A D. For supposing the force with which the body strikes the plane to be represented by B A, it may be resolved into the two sides B F and F A of a parallelogram, A F B D, the one parallel to the plane and the other perpendicular to it. The body impinges against the plane with a force F A alone; but, being perfectly elastic, it will be reflected from the plane with a force equal to F A, and in the same direction. The collision will, however, produce no alteration on the force in the direction B F or D A. At the same time, therefore, that the body is reflected from the plane with a force equal to A F, it will be carried along in the direction B F or D A, by a force A E equal to B F, and will therefore describe A C, the diagonal of a rectangle under F A and A E, equal to the rectangle A F B D, and the angle C A E will be equal to B A D.

Prop. X.—To determine the paths after collision of two perfectly elastic spherical bodies moving at a given angle before collision.

Let A and B (Fig 10. Pl. 119.) be two perfectly elastic spherical bodies moving at a given angle, A E B, before collision, and with given velocities, it is required to determine their paths after collision.

Let the velocities with which they move before collision be represented by A E and B E. It is evident that the distance of the centres, C and D, of the bodies at collision, from A and B, their situations before put in motion, or A C and B D, will be proportional to A E and B I, the spaces passed over being as the velocities. Let C D be the line joining the centres of the bodies at meeting, and A L and B K perpendiculars from A and B in its extension; from the resolution of forces, it is evident that A L will represent the velocity of A in the direction A L, and L C, its velocity in the direction of C D, the line that joins the centres of the bodies at collision; and also that B K will represent the velocity of B in the direction of B K, and K D its velocity in the direction of D C. The velocities A L and B K will be unaltered by collision. The change which takes place on the bodies in the directions C L and D K, may be determined by Prop. VI.; and calling them $a$ and $b$, the direction of A will be the diagonal of a rectangle under $a$, and C O equal and parallel to A L; and the path of B, the diagonal of a rectangle under $b$ and D P, equal and parallel to B D.

It is evident that, since the triangle A E B and the figure A C D B are given, that the triangles A L C and B D K are also given; and hence the velocities A L, L C, and B K, K D, may be found.

When bodies are imperfectly elastic, the results are not the same as here obtained; the changes, however, which take place on their collision, may be determined in a similar way. When one imperfectly elastic body overtakes another, the velocity lost is not double what takes place in the case of perfectly hard bodies, but bears a given ratio to it; the same holds with regard to the velocity gained by the body which is overtaken. In imperfectly elastic bodies the sum of the products of the bodies into the squares of their velocities does not, as in perfectly elastic bodies, continue the same after collision as it was before it; though still, agreeably to our second law of motion, the quantity of motion, estimated in a given direction, remains the same.

From a consideration of the theory of the collision of bodies, whether elastic, unelastic, or imperfectly elastic, it may be inferred, that if each body be multiplied into the square of the change that takes place in its velocity by collision, the sum of the products is a *minimum*. This law was discovered by Maupertuis, and is known by the name of the *principle of least action.*

For more particulars on the interesting subject of percussion, see Musschenbroek or Gravesende ; also Maclaurin's *Account of Newton's Discoveries ;* Keill's *Introduction to Natural Philosophy ;* Playfair's *Outlines,* &c. See also what is said on the game of *Billiards* in the article GAMES in this work.

### SECT. III. *Of Motion uniformly accelerated and retarded—of the Pendulum, Projectiles, &c.*

Prop. I.—If we suppose a body acted upon by the same accelerating force, its velocity will increase proportionably to the time ; and the spaces it describes in successive equal portions of time, will be as the squares of these successive portions of time.

Let us suppose the line A O (Fig. 7. Plate 119.) to represent time, and that it is divided into small portions A B, B C, C D, &c. all equal to each other ; if B H represent the velocity of a body A in the time A B, and C I in the time A C, D K in A K, &c. C I is double of B H, D K treble, and so on ; *i. e.* the velocity increases as the time.

The space described by an uniform motion is, by our theorem in the first section, equal to the velocity multiplied into the time ; that is, as the rectangle contained by the lines which represent the velocity and the time. Therefore, the spaces described in the times A B, B C, C D, &c. with the velocities B H, C I, D K, &c. are as the rectangles A H, B I, C K, &c. and the spaces described in the whole time as the sum of the rectangles. If, now, we conceive the number of parts A B, B C, C D, &c. into which line A G is divided, to be infinitely small, the sum of the rectangles A H, B I, C K, &c. will become equal to the triangle A G N ; therefore, the spaces described in any times, A G, A O, from the beginning of the motions, are as the areas of the triangles A G N, A O P. But as (*Euclid,* VI. 19.) similar triangles are to one another in the duplicate ratio of their homologous sides, or as the squares of those sides, the spaces will be to one another as the squares of the times.

Cor. 1.—Hence the space described by a body uniformly accelerated, reckoning from the beginning of the motion, is equal to the half of the space described by a body in the same time with a velocity equal to that acquired by the body uniformly accelerated at the end of that time. For the space described by a body moving uniformly, is equal to the rectangle under the time and the velocity, ($S = V \times T$, according to formula given above) ; that is, the space passed over by a body proceeding with a velocity O P in the time A O, is equal to A O × O P. But this rectangle is double of the triangle A O P, which represents the uniformly accelerated motion.

Cor. 2.—If the accelerating force be supposed greater or less in any given ratio, it is evident that the velocities will be increased or diminished in the same ratio ; and after any time, the velocity generated by the forces will be in a ratio compounded of the time and the forces.

Cor. 3.—This proposition is also applicable to motions uniformly retarded, only the times and the motions are to be taken in the contrary order till the motion is exhausted. If, therefore, a body be projected directly upward, it will lose, in every second of time, a velocity equal to what is generated in a falling in a second. Consequently, the greatest height to which a body can ascend, when projected directly upwards with any velocity is equal to the height from which it must have fallen to acquire the same velocity.

The *velocity generated by gravity* in a second, is about $32\frac{1}{6}$ feet ; for a body falling from rest moves about 16 feet and an inch in the first second ; but by our first corollary to this proposition, if it had moved for a second with the velocity which it had acquired at the end of that time, the space which it passed over, or its velocity, would have been twice $16\frac{1}{12}$ or $32\frac{1}{6}$ feet. At the end of another second the velocity, consequently, will be 64 feet (neglecting fractions ;) at the end of a third 64 + 32, or 96 feet ; after a fourth, 96 + 32, or 128, &c.

The spaces described by a heavy body in each successive second is as the series of the odd numbers, 1, 3, 5, 7, &c. In the first second it is 16 ; in the next second, if it were to proceed with a velocity equal to what it had acquired at the end of the first, it would be equal to twice 16, or 32 ; but as it will be acted on by the accelerating force of gravity for this second also, the space will be equal to three times 16, or $32 + 16 = 48$. As, at the end of this second, the velocity of a falling body is equal to 64 feet if it were not acted on by gravity, for the third second the space passed over would be equal to four times 16 feet ; but as the force of gravity still continues, the space passed over will be 16 feet more, that is, five times 16, or 80 feet. In the fourth second the body will pass over a space equal to seven times 16, or 112 feet, and so on.

In like manner, it may be shown, that the spaces described by a heavy body in succeeding seconds, reckoning from the beginning of the motion, will be as the squares of the natural numbers, that is, as 1, 4, 9, 16, &c. ; for in the first second it shall have described 16 feet, in the next 64, in the third 144, and so on. This conclusion might likewise be derived from the circumstance, that the continued addition of the odd numbers yields the squares of all numbers from unity upwards.

All bodies would fall to the earth with equal velocities if it were not for the resistance of the air. This is often shown experimentally by letting a guinea and a feather fall at the same time, from the same height, in the exhausted receiver of an air-pump. The resistance of the air retards a falling body considerably, even when, from its density, it is of such a nature as to be least affected by the action of the air. Thus, Dr Desaguliers found, that a leaden bullet, dropped from an altitude of 272 feet, took four seconds and a half to reach the ground. By theory, the descent should have been 325.6 feet in the same time ; which makes a difference of about one-fifth between experiment and theory.

Prop. II.—A body A, (Fig. 11. Pl. 119.) acted upon by the force of gravity, will descend along a plane inclined in the direction of any cord A B, and of the same length with that cord, in the time in which it would have fallen through the diameter A D of a circle of which A B is a cord.

For, draw the horizontal line B E. Let the force with which A descends to E be represented by A E, and let it be resolved into E F, perpendicular to A B and A F in the direction of the plane, the body is urged along the plane A B by A F alone, E F being destroyed by the reaction of the plane. Therefore, the forces with which the bodies descend to E, and along the inclined plane, are represented by A E and A F. But the spaces described by uniformly accelerated forces, are in the ratio of these forces; therefore, the bodies will fall from A to E and from A to F in the same time. But because the triangles A F E and A B D have a common angle at A, and are right angled at F and B, A B D being a semicircle, A F : A B : : A E : A D. Therefore, a body &c.

Cor. 1.—Hence, at all equal heights above the surface, as at B and E, B E being a horizontal line, the velocities of bodies are the same whether they have fallen freely to the ground or along an inclined plane; for the velocities generated in the falls were shewn (Cor. 2. last Prop.) to be in a ratio compounded of the forces and the times; that is, in the present case, in the ratio of $A\,F \times A\,B$ to $A\,E^2$, which is evidently a ratio of equality, for the lines A B, A E, and A F are (*Euclid,* VI. 8.) continued proportionals.

Cor. 2.—Hence likewise it may be inferred, that if a body fall from A to the horizontal line E B along any number of planes, as A G, G H, H I, I B, (or AG′, G H′ H I′, I′ B′) inclined any how to each other, the velocity at B will be the same as if it had fallen in the perpendicular A E. The same conclusion will hold if the number of the planes be so multiplied as that the surface shall be rendered curvilinear.

We may infer (from the third Cor. to the first Prop. of this section,) that if a body descend from A to B, (Fig. 12. Plate 119.) over a series of inclined planes or curved surface A B, the velocity which it has acquired at B will carry it to a height, C, equal to that from which it fell, over a similar series of inclined planes or curved surface B C.

The *pendulum,* which is a body suspended by a fixed point, and swinging freely backwards and forwards about that point, may be regarded as a body descending by the force of gravity along a circular arc, and ascending as high on the opposite side along a similar arc, by the impetus which it has acquired in its fall.

Prop. III.—If a pendulum vibrate in a circle, the force by which it is accelerated as it approaches the lowest point is nearly proportional to its distance from that point.

If two pendulums vibrating in the same circle are let go from the points B and B′, (Fig. 13. Plate 119.) they will be solicited toward the lowest point C, with forces which are nearly proportional to the distances B C and B′C from the lowest point of the circle C, the arcs being small. For, if the force of gravity be represented by B E and B′ E′, it may be resolved into F E and F′ E′ parallel to the pendulums, and B F and B′ F′ perpendicular to their direction. F E and F′E′ will be destroyed by the reaction of the string; the pendulums will therefore be urged towards C by the forces B F and B′ F′ alone. Now, as the arcs B C and B′ C are supposed very small, the sectors A B C and A B′ C may be regarded as triangles similar to B E F and B′ E′ F′; wherefore we shall have BF : B E : : B C : A C and B′ F′ : B′ E′ : : B′C : A C; and therefore $B\,F = \frac{BE \times BC}{A\,C}$ and $B'F' = \frac{B'E \times BC}{A\,C}$ Consequently we shall have B F : B′ F′ : : BE×BC : B′E′ × B′C; and since the force of gravity is in both cases equal, or B E = B′ E′, B F will be to B′ F′ as B C to B′ C. Therefore, if, &c.

Cor.—Hence, since (Prop. 1. Cor. 2. of this sect.) the velocities of bodies are as the spaces described by them when the times are equal, and since moving forces are as the product of the velocities by the masses, it follows (the moving forces being here as the product of the masses by the spaces described) that the times in which the spaces are described are equal. From this we see the use of the pendulum as a regulator for clocks and time-keepers; for when their vibrations are small, though unequal among themselves, they are all nearly isochronous, or of the same duration.

Prop. IV.—The time of the vibration of two pendulums of different lengths describing similar arcs, is in the ratio of the square root of those lengths; for the space described by one of them will be to the space described by the other, as the length of the one to the length of the other. But the spaces described by two bodies acted on by the same accelerating force are as the squares of the times. Hence, calling $t$ the time of a vibration of one of them, $t'$ of the other; $s$, the space described by the one, $s'$ that described by the other; $l$, the length of the one, $l'$ the length of the other; we shall have $s : s' : : l : l'$ or $t^2 : t'^2 : : l : l'$; and consequently $t : t' : : \sqrt{l} : \sqrt{l'}$.

Hence, if we know the time that a pendulum of a given length takes to perform a vibration, we can easily find what length a pendulum ought to have in order that it may perform a vibration in any other time. Thus, it having been found that a pendulum 39·14 inches swings seconds in the latitude of London, we discover, by a simple proposition, that it will require one 11,742 feet to swing minutes: for 1″ : 60″ : : $\sqrt{39{\cdot}14}$ : $\sqrt{140895}$ inches, or 11,742 feet.

If a circle A D E (Fig. 14. Pl. 119.) be made to evolve along a straight line A B, any point in it, as A, will describe a curve line A C B, which is called a cycloid. The line A B is called the base of the cycloid, the circle A D E the generating circle, and G C the axis.

If a pendulum F H be made to vibrate in a cycloid, as A C B, which may be effected by causing it to move between two semicycloidal cheeks, A F and B F, of which the generating circle is the same as that of A C B, all it vibrations, whether long or short, will be of the same duration. This was demonstrated by the celebrated Huygens. He likewise proved, that the time of a complete oscillation in the cycloid is, to the time in which a body would fall through the axis, as the circumference of a circle to its diameter. And since the cycloid may be considered as coinciding in C with a small arc of a circle described from F with the radius F C, the time of a complete oscillation in a small arc of a circle is to the time in which a body would fall through half the radius as the circumference of a circle to its diameter.

By means of this proposition, the pendulum enables us to ascertain the force of gravity much more accurately than can be done by actual experiment;

for, since the spaces which bodies uniformly accelerated describe are as the squares of the times, the space which a heavy body will fall through in the time of a small vibration of a pendulum, will be to half the length of the pendulum as the square of the circumference of a circle to the square of its diameter. Now, Captain Kater found, that in the latitude of London, at the level of the sea, and temperature of 62° Fahrenheit, the seconds pendulum measured 39·1386 inches, whence we have this proportion, as

$1^2 : (3{\cdot}14119)^2 :: 19{\cdot}5693$, or $\frac{39{\cdot}1386}{2} : 193{\cdot}141$

inches, or 16·095 feet.

The subject of pendulums vibrating in cycloidal arcs is treated of by almost every writer on mechanics. Maclaurin, in his Account of Newton's Discoveries, handles it in a very clear manner.

Owing to the centrifugal force caused by the revolution of the earth on its axis, the force of gravity, and, consequently, the length of the seconds pendulum, is different in different latitudes. At the equator it is about 39·00432; at 45°, 39·10696; at London, according to Captain Kater, 39·1386; according to others, 39·13009, and 39·126; at Edinburgh, 39·14104; and at the pole calculated to be 39.20690.

*Projectiles.*—Prop. IV. If a body be projected in a line not perpendicular to the horizon, its path will be a curve in a vertical plane passing through the line of projection.

For, let us suppose a body projected from A, (Fig. 16. Pl. 119.) in the direction A W, so as to describe equal spaces A B, B R, R S, S T, T V, &c. in equal times. If, when it has arrived at B, it receives an impulse in the direction B X, which would cause it to fall through B H in the time in which it would have moved through B R, by the composition of the forces, it will be carried in the direction B C, the diagonal of the parallelogram under B H and B R. If it now be left free to proceed in the direction B C, it will go on describing equal spaces C N, N E, &c. in the time in which it moved through B C. But if, instead of being allowed to proceed freely in that direction, it receives an impulse C I downwards at the point C, equal to B H, it will follow the diagonal of the parallelogram under C I and C N. In the same manner, if, instead of being allowed to proceed in the lines D O, E P, or F Q, it receives new impulses in the direction of gravity at the points D, E, and F, it must move in the diagonals D E, E F and F Q of the parallelograms under D O, D K; E L, E P; and F M, F Q. So that a body projected in any direction A W, receiving successive vertical and equal impulses at regular intervals, will pursue a polygonal path at A B C D E F G, and if these impulses are repeated at infinitely small intervals, that is, if the force attracting the body downwards is constant, the path, instead of being polygonal, will be curvilinear.

The curve described by a projectile must evidently have the following property, viz. that if a number of lines as B X, R Y, S Z, &c. be drawn through it in the direction of gravity, from equidistant points in the line of projection; and if their points of intersection with the curve be joined by the cords B C, C D, D E, &c. and these cords produced to meet the nearest vertical lines in N, O, P, &c. the portions R C. N D, O E, &c.' intercepted between them and the curve, will be all equal.

This is a property which can easily be proved to be peculiar to the curve called the parabola, one of the conic sections. For, to use the words of Dr Robison, "as the circle is the curve of uniform deflection in the direction of the radius, so the parabola is the curve of uniform deflection in the direction of the diameter."

It is also demonstrable that the directrix of a parabola described by a projectile, will be found by taking on the perpendicular from A, a line A E, equal to the height from which the body must have fallen to acquire a velocity equal to that with which it is projected, and drawing through this point a line parallel to the horizon. For a full account of the theory of projectiles, and its application to gunnery, see Robison's *New Principles of Gunnery*, Hutton's *Mathematical Dictionary*, art. *Gunnery*, &c. See also what is said on this subject in the article WAR, in this work.

Here we are naturally led to say something on the *forces by which the planets are retained in their orbits.*

If a body tending to a fixed centre be projected in a straight line not passing through the centre, it will move in a curve, and the straight line joining the centre will describe equal spaces in equal times. To make this appear clearly, let us suppose the body A projected in the direction A D, (Fig. 15. Pl. 119.) if no new force act upon it, it will proceed in that direction, describing equal spaces, A B, B C, C D, &c. in equal times; and if we imagine a straight line always drawn to a fixed point S, the areas A S B, B S C, &c. will always be equal, because they will have equal bases and a common vertex. If, now, we suppose a force B F to act in the direction B S on the body, when it has arrived at the point B, such as would cause it to descend to F in the time in which it would have moved from B to C by the motion first impressed on it, by the composition of forces it will describe B E, the diagonal of the parallelogram under B C and B F, in the same time, and the area B S E will be equal to the area B S C, because the triangles stand on the same base B S, and between the same parallels B S, C E; that is, the space described by the straight line drawn from E to the fixed point S, is equal to what it would have described if no new force had been impressed on the body. Since, then, one impulse towards the fixed point has no effect upon the area described by the straight line drawn from the body to that point, a successive number of impulses will have no effect on it either. If, therefore, we suppose the force bending the body to the fixed centre to act uniformly, it will bend the path into a curve, but will have no effect either to increase or diminish the area described in a given time by a line drawn from the body to the centre, though it may accelerate or retard its velocity.

By applying the converse of this proposition, viz. that if a body move in a curve, and if the areas which a line drawn from it to a fixed point describes, be proportional to the times, the body tends continually to that point, Sir Isaac Newton was led to conclude that the moon was a heavy body gravitating towards the earth. By generalizing this inference, he made the sublime discovery, that gravity is a principle pervading the whole solar system, and perhaps reaching to the fixed stars; that by it the secondary planets are retained in their courses round the primary planets, and the primary planets regulated by it in their orbits about the sun.

The paths of the planets are found to be ellipses. The ellipse, like the parabola, is also a conic section. This subject, however, belongs more properly to physical astronomy than mechanics. Those who wish to pursue it will find it fully treated of in Playfair's *Outlines*, Vol. II.; Robison's *Mech. Phil.* Vol. III.; and in Maclaurin's *Account of Sir I. Newton's Discoveries*, &c.

### SECT. IV. *Of the Equilibrium of Fluids.*

The term *fluid*, as used here, is not meant to include the electric or gaseous fluids, but rather such as may be termed liquid, as water, &c. The part of mechanical science which treats of fluids is commonly called *hydrodynamics*. That branch of it which comprehends the *equilibrium of fluids* is termed *hydrostatics*, while the department which embraces their motion is denominated *hydraulics*. What we have to say on the theory of these two branches of physical philosophy, is contained in the two following sections.

*Definition.*—A fluid is a body of such a nature as to be disposed to yield to the least difference of pressure. The particles of fluids are so small as not to be distinguishable by the microscope. Some philosophers have, however, reckoned themselves entitled to conclude, that they are hard, from the difficulty with which they can be compressed, and round and smooth, from the facility with which they move on each other. According to Boscovich's theory, a perfect fluid is a body of which the action of the particles is the same in every direction.

*Compressibility of liquids.*—Liquids were long thought to be incompressible. More accurate experiments, however, have led to a different conclusion. M. Canton having placed water in a glass tube under the receiver of an air pump, found that the water rose in the tube as the air was rarified. When he subjected it to condensation under the receiver of a condensing machine, it sunk in the tube. By his experiment, it would appear that spirit of wine may be compressed 66 millionth parts of the whole; olive oil 48 millionth parts; rain-water 46; sea-water 40; and mercury 3. According to the experiments of M. Zimmerman, sea-water subjected to a pressure equal to the weight of a column of a thousand feet of sea-water, suffers a condensation equal to $\frac{1}{340}$ part of its bulk. Mr Perkins has lately found that water may be compressed $\frac{1}{212}$ part of its bulk.

Prop. I.—When a fluid is undisturbed, its surface is everywhere horizontal, or perpendicular to the direction of gravity. This follows directly from the nature of a fluid, viz. that it yields to the force of pressure, however small, in every direction, and from the action of gravity being every where equal.

Hence, if a communication be made between two vessels of water, by a pipe crooked or straight, the water will not arrive at a state of equilibrium till it come to the same level in both vessels. By taking advantage of this principle, water may be conveyed in pipes over hills and vallies to any height not so great as the level of the spring from which it flows.

The Romans have been accused of being ignorant of the fact, that water in pipes will rise to the height of its source, from their conveying water to the city by aqueducts constructed at such enormous expense, and carried through hills and over vallies for many miles. The inference is perhaps rash. The fact is, they did use pipes (*fistulae*) in conveying water, and Pliny says, *Aqua in plumbo subit altitudinem exortus sui*,—water in leaden pipes rises to the height of its source, (XXXI. 6. § 31.) The truth is, no pipes could have conveyed to Rome the quantity of water made use of in the baths, &c.

Prop. II.—Any particle of a fluid at rest in a vessel, and subjected to the action of gravity alone, is pressed by a force equal to the weight of the superincumbent column of water in every direction.

This also follows from the nature of a fluid; for since it is a body which yields to the smallest pressure, any particle pressed more in one direction than another, would move to that side where the pressure was least, until equilibrium were restored.

This property of fluids is called the *quaquaversal pressure.*

From this proposition we may infer, as a corollary, that the pressure on every part of the sides and bottom of a vessel is proportional to the depth of the fluid at that point, and not at all connected with the horizontal extent. Thus if a vessel of the shape A D B C be filled with water or other fluid, the pressure on every point of the bottom will be the same as if it had been of the shape A E B C F, and filled to the same height, Fig. 1. Pl. 120. This is called the hydrostatic paradox.

Mr Ferguson illustrates this subject by the following experiment. Two vessels, (Fig. 2. Pl. 120.) such as A B and A B, are taken, of very unequal contents, open at both ends, and of the same width at the base. A neat brass bottom, as A D, A D, is got for each, large enough for them to stand on, and attached to them by hinges at A and A. The bottoms are kept up to the vessels by a weight and pulley at E and E, (the weights of course are equal,) a piece of wet leather being laid on each of them for closeness. If then the vessels be held up, and water poured into them slowly, it will be found that the height at which the water stands, when the pressure overcomes the weights and the bottoms give way, will be the same in both.

Hence if a long narrow tube be fixed vertically in the head of a cask full of water or other liquid, and water poured into the tube to fill it, even though it does not exceed an ounce, the cask will be in as much danger of bursting as if it had been continued up of the full size, and filled with water to the height at which the water stands in the tube. The pressure may be produced in the small tube by any kind of force as well as by the addition of a little water, or by the working of a piston for instance. On this principle, Bramah's cranes, presses, &c. are constructed.

Prop. III.—A body immersed in a fluid is pressed up by a force equal to the weight of the water displaced.

Suppose E F (Fig. 3. Pl. 120.) a body floating in a vessel A D C B, and G H to be the water line, the whole column E M K H, is equal in weight to any other K L of the same base; and taking the equal parts F M and F O from both, the weight of F L is equal to that of F E, or the body is pressed up with a force equal to the weight of water which it has displaced.

The same holds though the body sinks; for, unless we suppose it to lie so close on the bottom as to prevent the water from getting below it, from the quaquaversal pressure of bodies it must be pressed up by a force equal to the weight of a column of water of the height which it stands at in the vessel, and of a base equal to that of the immersed body; but it is pressed down only by a column of this base, and not so deep by the attitude of the body. Even a body lighter than water will remain at the bottom of a vessel filled with water, if the fluid be prevented from getting below it. Any person may satisfy himself of the truth of this, by a simple experiment. Let him take two flat pieces of wood made quite smooth on the surface, cement the one of them to the bottom of an empty vessel, and lay the other upon it; if he keep it down by his hand or a stick till he has poured water into the vessel so as to cover both boards, the loose piece will remain at the bottom even after his hand or the stick is removed, being pressed down by a column of water equal in height to the distance of the surface of the water from its top. If, however, it be raised ever so little at the edge, so as to allow the water to get below it, it will immediately rise to the surface of the water. Of course, the loose piece of wood must not exceed a certain thickness. Hence we may easily estimate the weight of a ship as she floats in the water; for if we multiply the number of cubic feet under the surface of the water by 64.4, (the weight in pounds of a cubic foot of sea-water,) we shall have the weight of the ship and all she contains.

*Specific gravities.*—The weight of one body compared with the weight of another body of the same size, is called its *specific gravity*. The specific gravity, therefore, of a body, is the weight of the body with relation to its bulk. Consequently, if we divide the weight of a body by its bulk, the quotient will be the specific gravity. In strictness, the weight of a body cannot be divided by its bulk, the quantities being of different kinds, and not admitting of a common measure.

But we may express the bulk of any body in cubic inches or some such unit, and we may denote its weight by referring it to some similar unit, the weight of a cubic inch of water for instance, in which case the weight may be divided by the bulk.

It clearly follows, from our last proposition, that the difference between the weight of a body in air, or more correctly in *vacuo*, and when immersed in a fluid, is equal to the weight of a quantity of the fluid of the same bulk as the body. If, therefore, we call W the weight of a body as weighed in air, and W′ its weight in water, W W′ will be equal to a quantity of water of the same bulk as the body; and $\frac{W}{W-W'}$ its specific gravity.

The instrument by which the specific gravity of bodies is ascertained is called the hydrostatic balance, (see *Balance*, Part II. Sect. 1. of this article.) If it be required to ascertain the specific gravity of a body lighter than water, the body may be weighed first in air, or in *vacuo*, and then being attached by a silk thread, or horse hair, to a heavy body of which the specific gravity is known, weighed together with it in the water. If from the gravity of the two bodies thus weighed together, the weight which the heavy body loses when weighed alone in the water is taken away, the remainder will be the weight in water of the body under examination.

The specific gravities of aeriform or gaseous bodies are determined in relation to atmospheric air. The way in which they are ascertained is this. A large glass vessel is taken, and the air of it exhausted by a good air pump; it is then weighed in a delicate balance, the air is admitted into it, and the vessel weighed again: the difference between the weights must evidently be the weight of the atmospheric air contained in the vessel, which we may call W W′. Let the vessel be again emptied of its air, and filled with the gas the specific gravity of which it is intended to ascertain; its weight when empty and when filled with the gas may be called *w w′*; consequently $\frac{ww'}{WW'}$ will be its specific gravity compared with that of atmospheric air. As the specific gravity of liquids, like solid bodies, is determined in relation to water, it may be got by weighing a vessel filled with water and then with the fluid of which the specific gravity is sought, and dividing the weight of the one by the weight of the other, taking away in both cases the weight of the vessel. For the different corrections made in ascertaining the specific gravity of bodies, see the different formulæ given by M. Biot, in his *Traité de Physique*.

### *Table of Specific Gravities.*

In estimating the specific gravity of bodies, that of water is reckoned 1·000 and all other bodies are measured in relation to it, except the gassous fluids which are determined in relation to atmospheric air, which is also taken at 1·000. As the specific gravity of air in the mean state of the atmosphere is ·00122, the relation of the gases to water is easily determined.

By an experiment of Mr Everard, balance-maker to the Exchequer, made in 1696, it appeared that 2145.6 cubic inches of distilled water, at the temperature of 55° Fahrenheit, weighed 1131 oz. 14 dwts. Troy weight. The experiment was made before the commissioners of the House of Commons, and the Exchequer standards were used. The balance turned with six grains when loaded with 30 lbs. in each scale. Hence, supposing the Avoirdupois pound equal to 7000 grs. Troy, a cubic foot of water weighs 62½ lbs. Avoirdupois, or 1000 oz. Avoirdupois, minus 106 grains Troy. Wherefore, if the numbers in the following table have the decimal point removed three places to the right hand, in other words, if they be multiplied by 1000, they will very nearly express the number of ounces Avoirdupois that are contained in a cubic foot of each substance: Or more accurately

# MECHANICS

Fig. 11

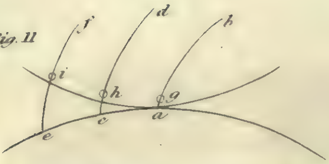


Fig. 7

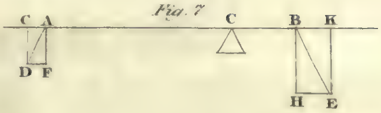


Fig. 6

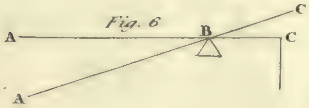


Fig. 23

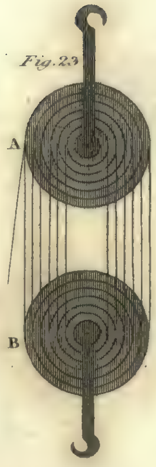


Fig. 14

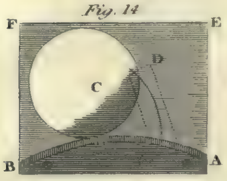


Fig. 15

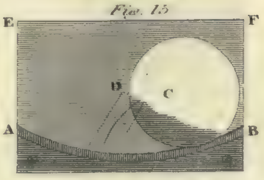


Fig. 17

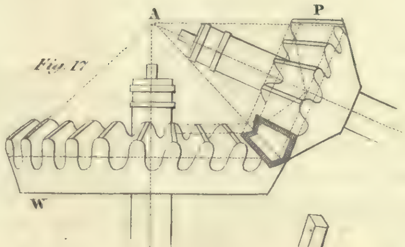


Fig. 18

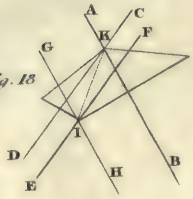


Fig. 21

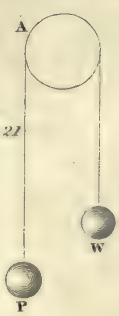


Fig. 22

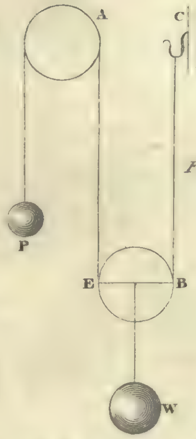


Fig. 19

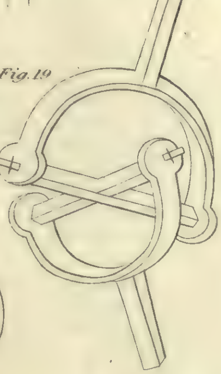


Fig. 24

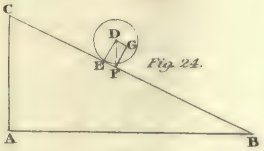


Fig. 9.

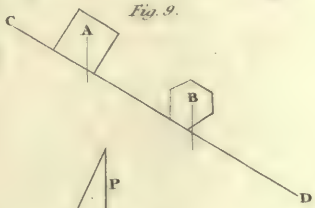


Fig. 16

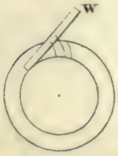


Fig. 10

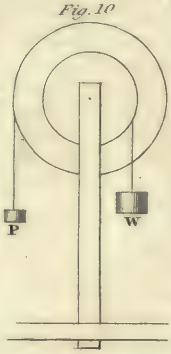


Fig. 13

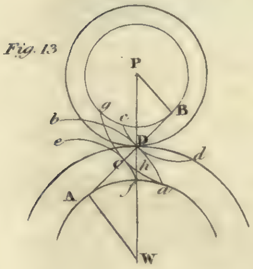


Fig. 20

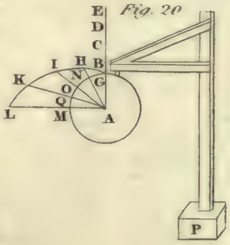


Fig. 12

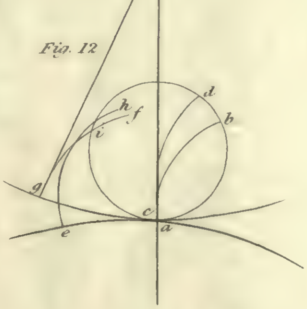


Fig. 1

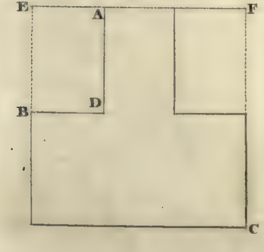


Fig 8

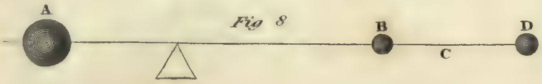


Fig. 2

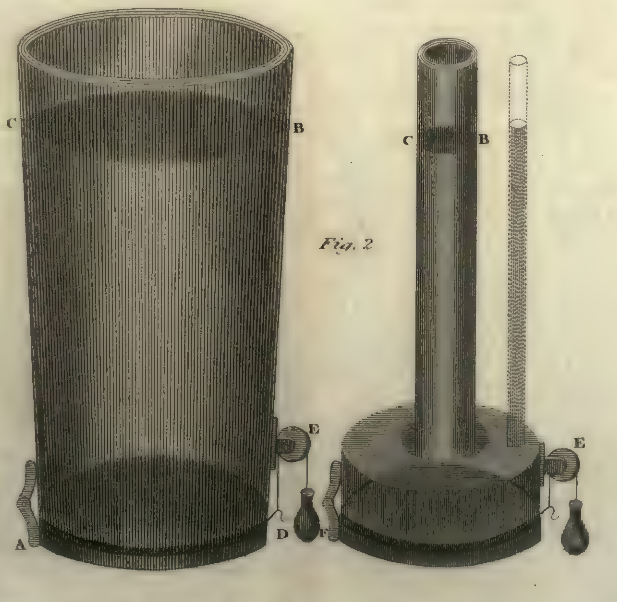


Fig. 3

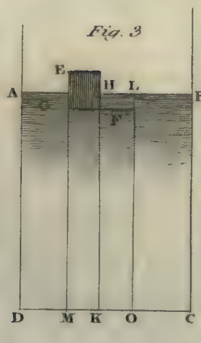


Fig. 4

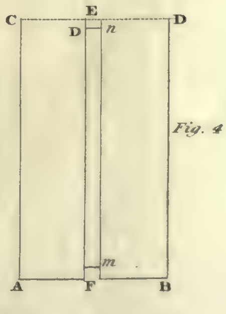
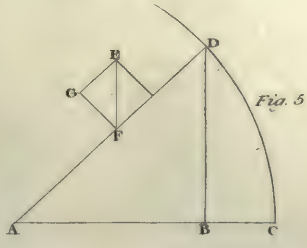


Fig. 5



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since a cubic foot of water at the temperature of 55° weighs 437489.4 grains Troy, the absolute weight of a solid foot of any substance will be found in grains Troy by multiplying its specific gravity by that number. See *App.* 8. *of Kerr's Translation of Lavoisier's Chemistry.*

### § 1. Metals.

| | |
|---|---|
| Platina, purified | 19.5000 |
| hammered | 20.3366 |
| Gold of 24 carats | 19·2587 |
| same hammered | 19·842 |
| English standard, 22 carats, fused, not hammered | 18·888 |
| Mercury at the temperature of 60° Farenheit | 13·580 |
| Lead | 11·352 |
| Silver, virgin, 12 deniers fine, not hammered | 10.474 |
| the same hammered | 10·510 |
| Bismuth in a metallic state | 9·822 |
| Copper not hammered | 7·788 |
| drawn into wire | 8·878 |
| Brass not hammered | 8·3958 |
| wire drawn | 8·544 |
| Cobalt, fused | 7·8119 |
| Nickel, fused | 7·8670 |
| Iron, cast | 7·200 |
| forged into bars | 7·788 |
| Steel | 7·767 |
| hammered | 7·840 |
| hammered and tempered | 7·818 |
| Tin pure, from Cornwall, fused | 7·170 |
| fused and hammered | 7·291 |
| Zinc, pure and compressed | 7·1908 |
| Antimony in a metallic state, fused | 6·7021 |
| glass of | 4·9464 |
| Arsenic, fused | 8·310 |
| native | 5·670 |
| Tungstan | 6.0665 |
| Molybdena, native | 4·084 |

### § 2. Stones.

| | |
|---|---|
| Diamond, oriental, colourless | 3·5212 |
| oriental, orange coloured | 3·550 |
| rose coloured | 3·531 |
| Brazilian | 3·444 |
| Ruby, oriental | 4·2833 |
| spinelle | 3·760 |
| Topaz, oriental | 4·0106 |
| Brazilian | 3·5365 |
| Sapphire, oriental, white | 3·991 |
| Brazilian | 3.994 & 4·283 |
| Girasol | 4·000 |
| Zircon or Jargon | 4·4161 |
| Hyacinth | 4·000 |
| Vermeille | 4·299 |
| Garnet, precious, Bohemian | 4·085 |
| common | 3.576 |
| Emerald | 2·683 & 2·673 |
| Chrysolite of the jewellers | 2·7821 |
| of Brasil | 2·692 |
| Byril, or oriental aquamarine | 3·5491 |
| occidental aquamarine | 2·723 |
| Rock crystal from Madagascar | 2·6530 |
| of Europe, or gelatinous | 2·6548 |
| Quartz crystallized | 2·6546 |
| amorphous | 2·6471 |
| Agate, oriental | 2·5901 |
| onyx | 2·6375 |
| Mocha | 2·5981 |
| Chalcedony, transparent | 2·5640 |
| Sardonix | 2·6025 |
| Prasium | 2·5806 |
| Jade or Nephrite, white | 2·9595 |
| Jasper, red | 2·6612 |
| cutlers | 2·1113 |
| Fountainbleau | 2·5616 |
| scythe of Auvergne | 2·5638 |
| mill | 2·4835 |
| Flint | 2·594 |
| Serpentine, green, Italian | 2·4295 |
| Talc, black crayon | 2·080 |
| common Venetian 2·800 and | 27·90 |
| Mica | 2·791 |
| Slate, common | 2·6712 |
| new | 2·8535 |
| Hone, white, razor | 2·8763 |
| black and white | 3·1311 |
| Iceland crystal | 2·7151 |
| Pyramidal calcareous spar | 2·7141 |
| Oriental or white antique alabaster | 2·7302 |
| Marble, white Carana | 2·7168 |
| white Parian | 2·8376 |
| Chalk | 2·252 |
| Spar, heavy | 4·430 |
| white fluor | 3·1558 |
| red, or false ruby | 3·1911 |
| Spar, green or false emerald | 3·1817 |
| blue or false sapphire | 3·1688 |
| violet or false amethyst | 3·1757 |
| Zeolite, red scintillant, from Edelfors | 2·4868 |
| white scintillant | 2·0739 |
| Pitchstone, black | 2·0499 |
| Porphyry, red | 2·7651 |
| horneblend or ophites | 2·97722 |
| Granitello | 3·0626 |
| Granite, red Egyptian | 2·6541 |
| beautiful red | 2·7609 |
| Aberdeenshire | 2·625 |
| Cornish | 2·662 |
| Pumice | ·9145 |
| Obsidian | 2·348 |
| Pierre de Volvic | 2·320 |
| Touchstone | 2.4153 |
| Basaltes from the Giant's Causeway | 2·864 |
| prismatic from Auvergne | 2·4153 |

### § 3. Vegetable Substances.

#### 1. *Woods.*

| | |
|---|---|
| Heart of oak, 60 years old | 1·1700 |
| English oak | ·960 |
| Cork | ·240 |
| Elm-trunk | ·6710 |
| Ash do. | ·8450 |
| Beech | ·8520 |
| Alder | ·8000 |
| Maple | ·7550 |
| Walnut | ·6710 |
| Willow | .5850 |
| Fir, male | ·5500 |
| female | ·4980 |
| Poplar | ·3830 |
| Apple-tree | ·7830 |
| Pear-tree | ·6610 |
| Plumb-tree | ·7850 |
| Cherry-tree | ·7150 |
| Filbert-tree | ·6000 |
| Box, Dutch | 1·328 |
| Yew, Spanish | ·8070 |
| Spanish cypress | ·6440 |
| American cedar | ·5608 |
| Oak, old and dry | ·606 |
| Lignumvitae | 1.333 |

#### 2. *Resins and Gums.*

| | |
|---|---|
| Common yellow or white rosin | 1·0727 |
| Mastic | 1.0742 |
| Stora | 1·1698 |
| Elemi | 1·0182 |
| Labdanum | 1·1862 |
| in tortis | 2·4933 |
| Rosin of jalap | 1·2185 |
| Dragon's blood | 1·2045 |
| Camphor | ·9857 |
| Gamboge | 1·222 |
| Myrrh | 1·360 |
| Bdellium | 1·377 |
| Galbanum | 1.2120 |
| Assafoetida | 1 3275 |
| Sarcocolla | 1·2684 |
| Opoponex | 1·6226 |
| Gum-Arabic | 1·523 |
| tragacanth | 1·3141 |
| seraphic | 1·201 |
| cherry-tree | 1·4817 |
| Bassora | 1·4346 |
| Acajou | 1,4456 |
| Monbain | 1 4206 |
| gutte | 1·2216 |
| ammonia | 1·2071 |
| Gayac | 1.2289 |
| liquid, from Botany Bay | 1.196 |
| lac | 1·398 |
| anime, eastern, | 1·0284 |
| western | 1·0426 |
| elastic, India rubber, or caoutchouc | ·9335 |
| Atouchi, an odoriferous gum | 1·0604 |
| Gum, joy, | 1·2948 |
| Euphorbium | 1·1244 |
| Olibanum, | 1·1732 |
| Inspissated juice of liquorice, | 1·7228 |
| of Acacia | 1·5153 |
| Aneca | 1·4573 |
| St John's wort, | 1·5263 |
| Terra Japonica | 1·3980 |
| Aloes, hepatic, | 1·3586 |
| socotrine | 1·3795 |
| Opium | 1·3366 |
| Indigo | ·7690 |
| Arnotto | ·5956 |
| Wax, yellow, bees, | ·9648 |

### § 4. Liquids.

| | |
|---|---|
| Water, distilled, | 1·000 |
| rain | 1·000 |
| sea | 1·0263 |
| of the Dead sea | 1·2403 |
| Alcohol, absolute | ·791 |
| highly rectified | ·8293 |
| commercial | ·8674 |

| | |
|---|---|
| Alcohol, 15 parts with 1 of water | ·8527 |
| 8 do. 8 do. | ·9427 |
| 1. do. 15 do. | ·9199 |
| Ether, sulphuric, from | .716 to ·745 |
| nitric | ·9088 |
| muriatic | ·7296 |
| Oil of filberts | ·916 |
| walnuts | ·925 |
| hempseed | ·928 |
| Oil of poppy-seed | ·929 |
| rape-seed | ·9193 |
| lintseed | ·9403 |
| whale | ·9233 |
| codfish | ·9233 |
| olives | ·9153 |
| sweet almonds | ·9170 |
| volatile of mint, com. | ·8982 |
| sage | ·9016 |
| thyme | ·9023 |
| wormwood | .9073 |
| sabine | .9249 |
| clover | 1.0363 |
| cinnamon | 1·0439 |
| turpentine | ·8697 |
| amber | ·8865 |
| lavender | ·8938 |
| Milk, woman's | 1.0203 |
| ass's | 1·0355 |
| cow's | 1.0324 |
| Cow whey | 1.0193 |
| Human urine | 1.0106 |
| blood | 1.054 |
| Acid, nitric | 1·5153 |
| do. highly concentrated | 1.2715 |
| muriatic | 1.1940 |
| red acetous | 1.0251 |
| acetic | 1.07 and 1.0095 |
| sulphuric | 1.8409 |
| do. highly concentrated | 2·125 |
| fluoric | 1.500 |
| phosphoric, liquid | 1·417 |
| solid | 2·852 |
| arsenic | 3·391 |
| boracic, in scales | 1·479 |
| melted | 1·803 |
| molybdic | 3·461 |
| benzoic | ·667 |
| Acid, formic | 1·11 |

### § 5. Gaseous Bodies.

| | |
|---|---|
| Gas, atmospheric, or common air | 1·000 |
| phosogene, or chloro-carbonic gas | 3·3888 |
| Gas, nitrous acid, calculated by *Sir H. Davy* | 2·427 |
| *Gay Lussac* | 3·176 |
| vapour of sulphuret of carbon | 2·6447 |
| of sulphuric ether | 2·5860 |
| of rodine, calculated at | 8·6195 |
| of hydriodric ether | 5·4749 |
| of oil of turpentine | 5·0130 |
| hydriodic acid gas | 4·4430 |
| fluosiliric acid gas | 3·5737 |
| chlorine | 2·470 |
| euchlorine, by *Sir H. Davy* | 2·409 |
| by *Gay Lussac* | 2·3144 |
| fluoboracic gas | 2·3709 |
| vapour of muriatic ether | 2·219 |
| chloro-cyanic vapour | 2·111 |
| sulphurous acid gas, *Sir H. Davy* | 2·193 |
| *Lussac* and *Thenard* | 2·1204 |
| vapour of alcohol | 2.1 |
| cyanogen | 1·806 |
| nitrous oxide, or proloxide of azote, *Sir H. Davy* | 1·614 |
| *Colin* | 1·5204 |
| carbonic acid | 1·518 |
| muriatic acid or hyenochloric, *Sir H. Davy* | 1·278 |
| *Biot* and *Arago* | 1·2474 |
| sulphureted hydrogen, *Sir H. Davy* | 1·777 |
| *Lussac* and *Thenard* | 1·7192 |
| oxygen | 1.104 |
| nitrous gas, or dentoxide of azote, by *Sir H. Davy* | 1.094 |
| *Berard* | 1·0388 |
| olefiant | 0.97804 |
| azote | 0·96913 |
| carbonic oxyde | 0·9569 |
| hydrocyanic vapour | 0·9476 |
| phosphuretted hydrogen | 0·870 |
| steam, by *Tralis* | 6896 |
| Gas, steam, *Gay Lussac* | ·62349 |
| ammoniacal, *Sir H. Davy* | ·590 |
| *Biot* and *Arago* | 0·59669 |
| Gas, carburetted hydrogen, *Thomson* 555, *Sir H. Davy* ·491 *Cruickshank* ·678 *Dalton* | 600 |
| hydrogen, *Thomson* ·073, *Sir H. D.* ·074, *Biot and Arago* | ·07209 |

### § 6. *Animal Substances, Vitrifications, Mineral Bodies, and others not included in any of the above classes.*

| | |
|---|---|
| Spermaceti | ·9433 |
| Butter | ·9423 |
| Fat of veal | ·9342 |
| mutton | ·9238 |
| beef | ·9232 |
| Tallow | ·9416 |
| Hogs fat | .9368 |
| lard | ·9478 |
| Glass, crown, of St Louis | 2·487 |
| flint of M. Dartiques | 3·20 |
| flint used by Mr Tully for his achrometic telescope | 3·334, 3·354, 3.192, and ·3237 |
| bottle | 2.7325 |
| green | 2·6423 |
| lorax | 2·6070 |
| gall | 2·8548 |
| Porcelain seves | 2.1457 |
| limoges | 2·3410 |
| China | 2·3847 |
| Sulphur, native | 2·0332 |
| melted | 1·9909 |
| Coal | 1·27 |
| Peat, hard | 1·329 |
| Edinburgh | 600 |
| Earth, common | 1·984 and 1·520 |
| loamy | 2·016 |
| Ambergris | ·7800 and ·9263 |
| Amber, yellow, transparent | 1.0780 |
| Gunpowder, in loose heap | .836 |
| solid | 1·745 |
| Bone of an ox | 1·656 |
| Urinary calculi | 1·434 |

## SECT. V. *Of the Motion of Fluids.*

In this branch of mechanical science, facts and theory by no means agree. Theory, indeed, in many cases affords hardly even an approximation to the truth. In what we have to say on this subject, therefore, we shall rather employ ourselves in giving an abstract of the results of the many experiments which have been made to extend our knowledge of the laws of the motion of fluids, than in any refined investigations. It will be necessary, however, to premise the following very important proposition, namely, that

The velocity wherewith a fluid issues from an opening in the bottom or side of a vessel, is equal to that which a body would acquire by falling through a height equal to that of the surface of the water above the orifice.

For suppose F *m*, Fig. 4. Plate 120. a small portion of water, over the opening F in the vessel A B C D filled with water as high as D C. Let there be taken at the top of the column a portion of the same height E *n*. A body falling through the height E *n*, acquires a force which is to that of a body falling from E to F in the ratio of E *n* to E F. The force with which the small portion *m* F is pressed by its own weight, is to the force with which it is pressed by the whole column, E F, as *m* F to E F. Thus the ratio between the forces E *n* to E F, and *m* F to E F, is one of equality. But the forces are in both cases produced by the same pressure of gravity; therefore the velocity of a body having fallen from E to F, and of the small portion pressed by the whole column E F, must be equal, for the forces of equal bodies are as their velocities. We may infer from this, as a corollary, that if a fluid be made to spout directly upwards with a velocity equal to what a body would acquire by falling through a height equal to the surface of the water above the opening from which it issues, it will rise as high as the level of the surface.

The demonstration which we have given here is the same as in *Muschenbroek's Nat. Phil.* § 1294. Reason would seem to authorise us to conclude, that the quantity of water issuing through an opening in the side or bottom of a vessel, must be equal to a column the base of which is the area of the opening, and the height the velocity with which it issues from the opening. Experiment, however, gives us a result less than what theory would lead us to expect, in the ratio of about 5 to 7. This arises from the contraction which the water is observed to suffer in passing through the opening. It is found that, in every instance, a fluid passing through a narrow opening suffers contraction. Professor Michelotti found, however, that when he made water pass through a mouth-piece, the cavity of which has a shape similar to what the run naturally assumes, the difference between the natural and theoretical result was next to nothing. This suggests to us the propriety of making the space in a reservoir or dam immediately above the sluice to contract gradually, in order that the quantity of water discharged from the opening may be a maximum.

From a variety of very accurate experiments, it has been found, 1st, That the quantity of water issuing from orifices of different areas at the same height in a vessel or reservoir, is as the areas of these orifices; 2d, That the quantities which issue from openings of the same size at different heights in a reservoir, are as the square roots of the heights of the surface of the water above those openings; 3d, That the quantities of water issuing from orifices of different sizes, at different heights in the reservoir, are in the ratio compounded of the areas of the orifices and the square roots of the heights of the surface of the water above them; and, 4th, That the quantity of water discharged from long horizontal pipes of the same size, is nearly in the inverse ratio of the square roots of the lengths. In this case, however, it is supposed that the length of the pipes is not very unequal. The three first conclusions here might have been derived from our first observation on the quantity of water issuing through an opening; for the difference of 5-7ths between the experimental and theoretical results affects only the absolute quantities, and not their proportions.

In a river, it has been found, as was naturally to be supposed, that the water runs with greatest velocity in the middle of the stream, and that it diminishes towards the bottom and sides, where it is least; being retarded by obstacles, friction, adhesion of its particles, &c. Du Buat ascertained, that if from the square root of the greatest velocity of the stream (expressed in inches per second) unity were taken away, the square root of the remainder would give the velocity at the bottom. He likewise found by experiment, that the mean velocity, or that with which if the stream were to move the discharge would be equal to the actual discharge, is equal to the arithmetical mean between the greatest and least velocities.

When water moves uniformly in any bed or channel, the accelerating force with which it flows must be equal to the sum of the resistances with which it meets. This proposition, which is in its nature little removed from an axiom, is the basis of all that is useful in hydraulic science.

The amount of the resistances, however, which water running either in pipes or in rivers meets with can be determined by multiplied and extensive experiments alone.

The Chevalier Du Buat was the first who succeeded, after many trials, in obtaining formulae to answer to facts, and to be of service in calculating what was the velocity of water in pipes and canals. These, as we said above, have been greatly simplified by M. Prony, and are of great use to the engineer.

Here we shall give M. Prony's formulae, as adapted to English measure by the late Professor Playfair. Let V be the mean velocity of the stream, measured by the number of inches it moves over in a second; $l$, the length of the canal or pipe; $z$, the difference of level of its two extremities; D the diameter in the case of a pipe; $h$, the height of the water in the reservoir above the upper opening of the pipe; $h'$ the height at which the water stands in the cistern into which it is emptied, above the lower opening. And calling the expression $\frac{h + z - h'}{l}$ (which is equal to the sine of the inclination of a point in the surface of the upper cistern, immediately over the orifice of the pipe above a similar point in the lower,) $=$ K, we shall have for pipes

$$V = -.1541131 + \sqrt{.023751 + 32806.6 \times \tfrac{1}{4} D K}.$$

And, in the case of rivers, calling R, the quotient obtained by dividing the section of the stream expressed in square inches by its border (or perimeter minus its superficial breadth) in linear inches, V, $l$, and $z$ being the same as before, and $\frac{z}{l}$ or the sine of the inclination of the extremities to each other being expressed by I, we shall have for rivers

$$V = -\cdot1541131 + \sqrt{\cdot023751 + 32806\cdot6 \times R L}.$$

These formulae give the velocity in English feet. It must be observed, that when the water from the lower end of the pipe is discharged into the air, $h'$ is equal to nothing.

It clearly follows, from our fourth proposition in section third, that water issuing from an opening in the side of a vessel, and also jets, if not vertical, have a parabolic path. The directrix of the parabola will be in the plane of the surface of the fluid; for the velocity with which a fluid issues from an opening in the bottom or side of a vessel is equal to what a body would acquire in falling through a height equal to the altitude of the surface of the water above the orifice. This, of course, is true only in a theoretical point of view. Friction, resistance of the air, &c. occasion a considerable deficiency from the expected result. It is found, by experiment, that the difference between the height at which the water stands in the reservoir, and the height to which the jet ascends is proportional to the square of the height of the jet. Water does not rise to the greatest height when the jet is vertical; it rises highest when slightly inclined from the perpendicular. When the jet is vertical, the ascent is impeded by the fluid falling back on the ascending column. The greatest height to which water rises in a jet is called *the height of the effective head*. The directrix of the parabola which an oblique jet describes is more correctly determined by supposing that it lies in a horizontal plane passing through the *effective head* than in a plane passing through the surface of the fluid.

On the fact, that a fluid issuing from a hole in the side of a vessel or reservoir describes a parabola, is founded the ingenious but useless *parabolic theory* of the motion of running water of Guglielmini. (See an account of it in Robison's *Mech. Phil.* Vol. II. article *River.*)

*Percussion of fluids.*—If the section of two streams have equal areas, they will strike planes directly opposite to them with forces which will be as the squares of the velocities; for the force of the whole stream will be as the force of each particular particle, and as the number of particles that strike in a given time. But the force of each particle is as the velocity of the stream, and their number is also as the velocity; therefore the whole force will be as the square of the velocity.

If, therefore, we call $v$ the velocity of the stream, $a^2$ the area of the section, and $m$ a co-efficient to be found by experiment, we shall have the force $= m a^2 v^2$. When the plane on which the fluid strikes is of indefinite extent, $m$ is equal to 1. Therefore, in that case, the force is equal to the area multiplied into the square of the velocity. When the plane is equal to the section of the stream, $m$ is equal to $\frac{1}{2}$, and, consequently, the force which the stream exerts is only equal to half the product of the area of the section by the square of the velocity.

If the plane which is struck by the stream be itself in motion, the impulse will be as the square of the difference of the velocities; that is, calling $v$ the velocity of the stream, and $c$ the velocity of the plane, the force with which it is struck will be $m a^2 \ (v - c^2)$.

*A priori* reasoning would lead us to conclude, that the resistance of a fluid to a body moving in it is equal to the force of a fluid striking against a body at rest, the velocities being equal; yet by experiment it is found that, the velocities being the same, the resistance to a body moving in the fluid is less than the percussion on a body at rest, in the ratio of 5 to 6.

Prop.—If a stream strike a fluid obliquely, the force is less than if it struck it directly in the ratio of the square of the sine of the inclination of the plane to the stream, to the square of the radius; for if we conceive a stream (Fig. 5. Pl. 120.) to strike a plane A D (which we shall suppose rectangular for the sake of simplicity) in the direction E F, we can only regard it as acting on a plane of the same altitude, with a base equal to A B = the sine of the inclination of the plane to the stream. Now, the force with which the stream would act directly on the plane A C = A D, would be to the force with which it would act on A B, as A C to A B, that is, as R to sin. $i$; for the velocities being the same, the forces must be as the areas of the planes on which they act, and these areas are here as their bases. But the fluid acting on A D, though to be regarded as a plane of no greater length than A B, evidently does not operate on it with its whole force, for the force of the stream E F is resolvable into F G perpendicular to the plane A D and E G parallel to it; the force G F, however, is the only one that takes effect. Therefore, the force acting on A B is to that on A D as E F to G F, that is, as R : sin. $i$; for from parallel and diverging lines the angle G E F = E F D = A D B. Whence the force with which the stream would strike A C is to that with which it would strike A B as the same force on A B to that on A D, and since these are continued proportionals, the force on A C is to that on A D as $R^2$ to $(\sin. i)^2$.

By experience, however, this conclusion is not found to hold unless when the angle of inclination is greater than 60°. From experiment, it would appear that the resistance to oblique planes consists of two parts; the one proportional to the square of the inclination, and the other to a certain power ($3\frac{1}{2}$) of the angle itself.

## PART II. PRACTICAL MECHANICS.

In this branch of mechanics, we shall treat of the following subjects: 1. The mechanical powers; 2. The strength of materials; 3. Friction; 4. The strength of men and animals as applied to move machinery; and, 5. Of various useful machines.

### SECT. I. *Of the Mechanical Powers.*

The simple mechanical powers, into a modification or combination of which all machines may be resolved, are, 1st, the lever; 2d, the wheel and axle; 3d, the pulley; 4th, the inclined plane; 5th, the wedge; 6th, the screw; to which some foreign mechanicians add, 7th, the funicular, or rope-machine. As the wheel and axle, and the pulley, may be looked on as different applications of the lever, so the wedge and screw may be regarded as modifications of the inclined plane. It will, however, be conducive to perspicuity to consider all of them separately.

*Of the lever.*—A lever is an inflexible bar or rod, crooked or straight, capable of moving freely round a fixed point called its centre or fulcrum.

The lever is of three kinds; of the *first kind*, when the fulcrum or centre is situated between the weight to be raised and the power made use of to overcome the resistance; of the *second kind*, when the *weight* is situated between the *power* and the *fulcrum*; and of the *third*, when the *power* is placed between the *weight* and the *fulcrum*. They are represented in Fig. 18. Nos. 1. 2. and 3. Pl. 119. the weight in each of them being at B, the power at A, and the centre or fulcrum at C.

Prop. I.—In the lever, if the powers applied be to the resistance to be overcome in a ratio which is inversely as their distance from the fulcrum, they will be in *equilibrio*, or the one will balance the other.

It will be sufficient to demonstrate this in one case, and let us take the lever of the first kind.

Let A C, Fig. 6. Pl. 120. be a lever moveable about its fulcrum B, and let us suppose it to have turned from the position A C into the position A′ C′. The space described by each of the points or their velocities will be as their distances from the fulcrum. If, therefore, the power A is to the weight or resistance at C as B C, the distance from the fulcrum of the point at which the weight acts, is to A B, the distance from the fulcrum of the point at which the power acts, the power will be to the weight as the velocity of the power to the velocity of the weight; their momenta, therefore, will be equal, and they will balance each other.

Hence, if the one arm A B of a line be 10 feet, and B C the other be 2 feet, a weight of 2 lb. at A will sustain a weight of 10 lb. at C; and a man with a lever of these proportions would be able to raise five times as much as he could by his unassisted strength.

Prop. II.—If both the power and the resistance act obliquely, an equilibrium will take place, if they are inversely as their distances from the fulcrum multiplied into the sides of the angles which their directions make with the lever.

For, let us suppose the lever A B, Fig. 7. Pl. 120. kept in *equilibrio* by the two oblique forces A D and B E, A D may be regarded as the diagonal of a rectangle C D F A, and may be resolved into the two forces G A and A F, the sides of the rectangle; but as G A is resisted by the fulcrum, the only force which acts at A is A F. In the same manner, the only force which acts at B is B H. Therefore, $A F \times A C = B H \times B C$. In the triangle D A F, $A F = A D \times$ sin. of inclination, and $B H = B E \times$ sin. of its inclination. Therefore, calling the power P, and the weight W; $P \times$ sin. inclin. $\times A C = P \times$ sin. in. $\times B C$.

This proposition evidently includes our first; for if either of the forces should act perpendicularly, sin. in. becomes equal to nothing.

When levers are bent or crooked, as in Fig. 19. Nos. 1. and 2. Pl. 119. and the forces inversely as the perpendiculars drawn to their direction from the fulcrum, the case coincides with that demonstrated in the former of these propositions. If the forces are oblique, it corresponds with the second. We have hitherto considered the lever as destitute of weight. Before speaking of the manner in which allowance is to be made for its gravity, and, indeed, before we can prosecute our subject farther, we must premise a few observations on the *centre of gravity*.

The *centre of gravity* is an imaginary point, by which, if a body is sustained or suspended, it will have no tendency to any angular velocity about that point, or will remain in *equilibrio*.

If two equal bodies be joined by a straight inflexible rod devoid of weight, their centre of gravity will be at an equal distance from both bodies. If the bodies be unequal, their centre of gravity will be a point which intersects the distances between the centres of the bodies in a ratio which is inversely as their weights. This is evident from our first proportion about the lever.

If the centre of gravity of three bodies, A, B, and D, Fig. 8. Pl. 120. connected by the straight inflexible rod A D, be required, we must first find the centre of gravity, C, of two of them, as B and D, and, supposing a body equal to their sum placed there, find the centre of gravity C of it, and the remaining body A. This will be the centre of gravity of the whole three bodies; for $B \times B C + D \times D G = (B + D) \times C C$. In like manner, the centre of gravity of any number of bodies may be determined.

It is evident, from what has been said, that in homogenous bodies the centres of magnitude and gravity must coincide.

The following is the method most useful in practice for finding the centre of gravity. If the body is nearly a plane, that is, of no great thickness, balance it over the edge of some other body lying in a horizontal position; this edge will mark a straight line on the surface of the body of which the centre of gravity is sought, in some part of which the centre of gravity will lie. Balance the body again in a direction about right angles to the former, and the centre of gravity will lie in the intersection of the lines marked on the surface of the body. If the body is light, a more simple method to find its centre of gravity will be to suspend it by attaching a string near the edge first in one point and then in another, and drawing straight lines in the direction of the string in both instances; the intersection of the lines will mark the *centre of gravity*. If the body be of considerable thickness, three suspensions or equilibrations will be necessary to ascertain the centre of gravity.

The *line of direction* is an imaginary line drawn from the centre of gravity, in the direction of gravity, *i. e.* towards the centre of the earth. In this line bodies would descend if allowed to fall freely. From the nature of the centre of gravity, it follows that, in reasoning about heavy bodies, we may consider their whole weight as concentrated in that point. If, therefore, the line of direction fall within the base of a body it will stand fast, but if it fall without the base the body must overset. Thus a sphere or cylinder would roll down an inclined plane, such as C D (Fig. 9. Pl. 120.); a body of the figure B would tumble down, while one of the form A would slide down. A body of the shape A B D C, (Fig. 17. Pl. 119.) inclined to the horizon, and with a base A B L M, if no higher than A C, would stand firm, the line of direction G H falling within the base; but were it raised to the height A E, unless the base at the same time were enlarged, it would tumble, for the line of direction I K would fall without the base.

When we would take into consideration the gravity of the lever, in estimating its power, we suppose the weights of the arms concentrated in their centres of gravity, and acting at those points as additional powers in the direction of gravity. Thus, in a heavy lever of the first kind, (Fig. 18. No. 1. Plate 119.) supposing the weights of each arm concentrated, as if in D and E, their centres of gravity, equilibrium will take place when the weight at $A \times A C + D \times D C =$ the weight at $B \times B C + E \times E C$. And calling D, (Fig. 18. No. 2.) the centre of gravity of the lever of the second kind, and supposing its weight accumulated there, an equilibrium will take place, when the power at $A \times A C, =$ the weight at $B \times B C +$ the gravity of the lever supposed concentrated in D, multiplied into D C, its distance from the fulcrum. And in the same way, in a lever of the third kind, (Fig. 18. No. 3.) calling D again the centre of gravity, an equilibrium will take place when the power at $A \times A C =$ the weight at $B \times B C +$ the weight of the lever multiplied into D C.

Hence, from the properties of the lever, we infer, that if a load be laid on a beam supported in a horizontal position by two props, the weights which they sustain is inversely as their distance from the weight. If two men, therefore, carry a burden between them over a stick, the quantity of it which they severally bear is proportional to their distances from it, he that is nearest it bearing the most of the weight, and he that is farthest off the least.

The lever is of very extensive use in mechanics. The apparatus for raising a drawbridge, which is in general use in Holland, (represented Fig. 20. Plate 119.) is a lever of the first kind combined with a lever of the second. The two levers are parallel, and in all situations remain in *equilibrio*.

We have instances of the application of the lever of the first kind in pliers, pincers, oars, rudders, crows, &c.; of the second in doors turning on their hinges, &c. The lever of the third kind is much used in the construction of the animal frame, the bone being the lever, the joint the fulcrum, and the muscle the power, or rather the medium through which the power is exerted.

### *Of the Balance.*

The common balance is a lever with arms of equal lengths: The centre of suspension S, (Fig. 21. Plate 119.) is placed above the centre of gravity A. If the centre of suspension were the same as the centre of gravity, equal weights would be in *equilibrio* in every position of the balance; but being suspended higher than their centre of gravity, they sustain each other only when A B is level. But if the weight at A is a little greater than that at B, the end A must descend till their common centre of gravity comes into the vertical line G S, where the one weight will balance the other, their centre of gravity being sustained by S.

The construction of a balance is a very nice operation, it being very difficult to combine perfect accuracy with great sensibility and great stability, or power of returning quickly into a state of rest after having been disturbed. In order that the balance be accurate or true, it is necessary that the arms be exactly of the same length. That this may be the more easily ascertained, the points to which the weights are attached should be exactly in the same straight line with the point of suspension. The sensibility increases in proportion to the length of the arms and distances between the centres of suspension and gravity. Yet care must be had not to separate the centres of gravity and suspension too far, for that injures the stability of the balance.

Writers on mechanics tell us of several very fine balances. Perhaps the best ever made is that of the Royal society, constructed by Ramsden. It is capable of weighing ten pounds, and turns with little more than $\frac{1}{200}$ part of a grain, that is, with about ten millionth part of the whole weight. It turns upon knife edges of tempered steel set on planes of polished crystal.

The *hydrostatic balance* differs little from a balance of the common construction nicely made; only at the bottom of each scale there must be a hook, in order that the bodies of which the specific gravity is to be ascertained may be suspended by a silk thread or horse hair.

The principle on which the *statera Romana*, or Roman balance, is constructed, may be understood by merely inspecting the representation of it, (Fig. 22, Plate 119.)

*Wheel and axle.*—(Fig. 10. Plate 120.) The second mechanical power, namely, the wheel and axle, consists of a wheel with a round or cylindrical axle passing through its centre, and turning on two gudgeons. The power is applied at the circumference of the wheel, and the weight at the circumference of the axle.

The wheel and axle may be regarded as a lever of the first kind, revolving on its fulcrum. And an equilibrium consequently will take place in the machine when P, multiplied by the radius of the wheel, is equal to W, multiplied by the radius of the axle.

To the wheel and axle may be reduced all sorts of cranes for raising weights, as also the capstan, the windlas, the crank, &c. The combinations of wheels, which are of such extensive use in machinery, may in general also be reduced to this mechanical power. The wheels, indeed, do not always turn on the same axis, but communicate often by belts or straps, or by means of teeth cut in the circumference of each of them.

When one wheel is put in motion by another, their velocities must evidently be equal; the number of revolutions, therefore, which they make, will be inversely as their radii. That is, if a wheel with a radius, as three, put another in motion which has a radius as one, either by a belt passing over them or by means of teeth, the wheel with the smaller radius will revolve three times for every turn of the larger wheel.

When one wheel moves another by means of straps or bands, if the bands be crossed between the wheels, they will move round on their axis in opposite directions; if the belts be not crossed, both the wheels will revolve in the same way. When motion is communicated from one wheel to another by means of straps or bands, because of their always slipping a little the one wheel does not cause the other to revolve so often as theory would authorise us to conclude.

A very neat method of moving light machinery has long been partially in use. It consists in covering the surface of the wheels with buff leather, and making them act on each other. Dr Brewster recommends, for the same purpose, a thin film of caoutchouc. Mr Taylor of Southampton adopted a method of communicating motion very similar to this, in a saw-mill which he erected. The wheels were made to act on each other by the contact of the end grain of wood. The machinery made little noise, wore well, and was in use twenty years.

When a toothed wheel puts another toothed wheel in motion, their teeth ought to be so constructed that they may move with an uniform angular velocity; for nothing tends more to injure machinery than sudden and jolting motions.

This is a subject, though of the very greatest consequence in the construction of machines, which has as yet attracted too little attention from the practical mechanic. We shall, therefore, endeavour to deliver some principles for the proper formation of the teeth of wheels, in as popular a manner as possible, referring those who wish for more information on the subject to Dr Brewster's *Appendix to Ferguson's Mechanics.*

*Terms explained.*—If a larger toothed wheel turn a smaller, the smaller is commonly termed a *pinion,* and its teeth are called *leaves.* If the smaller wheel consists of two cylindrical ends, connected by straight staves inserted at equal distances, it is then called a lantern, and the staves are termed trundles or spindles. The line joining the centres of a wheel and pinion is called the *line of centres.* If this line be divided in the ratio of the number of leaves in the pinion to the number of teeth in the wheel, the one part is called the *primitive radius* of the pinion, and the other the *primitive radius* of the wheel. These are consequently less than the real radii which extend from the centre to the points of the teeth, though they are proportional to them. The circles of which they are the radii are called the *primitive circles,* or *primitives* of the wheel and pinion.

The *curves* most convenient to be given to the teeth of wheels, in order that they move uniformly, are the epicycloid, the cycloid, and the involute of a circle. The epicycloid is a curve described by any point in the circumference of one circle rolling on the circumference of another. The circle which remains fixed is called the base of the epicycloid; the rolling circle is termed the generating circle. There are two kinds of epicycloids, which are called exterior and interior, according as they are produced by the generating circle rolling on the inside or outside of the circumference of the base. The cycloid, as formerly said, is a curve generated by any point of a circle rolling on a straight line. It may be regarded as an epicycloid of which the base is a circle of an infinite radius. The involute is a curve generated by any point of a thread wound about a cylinder and uncoiled; it is the same as would be produced by a point in the edge of a straight ruler made to turn on the circumference of a circle or cylinder. The conic sections, viz. the elipse, the hyperbola, and the parabola, have been recommended by M. Clapeyron as fit curves for the teeth of wheels. The others, are, however, to be preferred, as being of more easy description.

Prop. 1.—If the teeth of a wheel intended to drive a pinion have the shape of the epicycloid of which the generating circle is equal to the primitive radius of the pinion, and the base equal to the primitive of the wheel, and act on infinitely small pins on the circumference of the pinion, the motion of the wheel and pinion will be uniform; that is, their angular velocities will be equal, or they will describe equal spaces in equal times.

For (Fig. 11. Pl. 120.) calling the wheel W and the pinion P, and supposing $ab$, $cd$, and $ef$ small portions of epicycloids described by the equidistant points $g$, $h$, $i$, in the primitive of the pinion P rolling on the primitive of the wheel W: It is evident that the arcs $gi$ and $gh$, and consequently also $hi$, of the pinion, are equal to the corresponding arcs $ae$, $ac$, and $ce$ of the wheel; for, from the nature of the epicycloid, every point of the one circle must have been in contact with every point in the other. Therefore, if the wheel W drive the pinion P by means of infinitely small pins in the circumference of the pinion, they will describe equal arcs in equal times; in other words, their motions will be uniform.

Cor.—If the radius of a wheel driving a pinion become infinitely large, that is to say, if the primitive of the wheel be a straight line, it is evident that the proper curve to give the acting forces of the teeth is a *cycloid*; since it is merely an epicycloid of which the base is a circle of infinite magnitude. This case applies when the teeth of a rack drive a pinion. For a similar reason, if a pinion drive a rack (as in the air-pump, &c.) the motion will be uniform if the leaves of the pinion be involutes of a circle, and act on infinitely small pins in the edge of the rack.

As, in practice, it is necessary to allow for the size of the pins on which the teeth act, this may be done either by making the thickness of the pin to extend in a direction inwards from the point on which the tooth acts, or by supposing the edge of the tooth a curve parallel to the epicycloid which would be described by the centre of the pin at the distance of the radius of the pin.

Not to weaken the pins by cutting off from them what may not be necessary to produce motion, portions may be cut out between the teeth of the wheel to correspond to their shape.

Prop. 2.—If the teeth of a wheel are arcs of epicycloids described by a circle of any diameter rolling on the *convex* circumference of its primitive, and if the leaves of its pinion are arcs of epicycloids generated by the same circle rolling on the *concave* circumference of its primitive, the motion of the wheel and pinion will be uniform.

Suppose (Fig. 12. Pl. 120.) $ab$ an arc of an epicycloid formed by the rolling of the circle $idb$ on the convex circumference of the primitive of the wheel W, and $cd$ an epicycloidal arc generated by the rolling of the same circle $idb$ on the concave circumference of the primitive of the pinion P; if the acting surface of the teeth of the wheel have the form $ab$, while the acting surface of the leaves of the pinion have the form $cd$, the motion of the wheel and pinion will be uniform.

For let us suppose $ab$ and $cd$ moved into the positions $ef$ and $gh$, by the action of the one upon the other, they will meet in the circumference of the circle $idb$; for $gh$ is generated by the separation of $ci$ from $gt$ and $cf$, by the rising up of the same $ci$ from $ae$ they must therefore meet in $i$; and the base $ae$ being equal to the base $cg$, it follows that the spaces passed over in equal times are equal, or the motions are uniform.

Cor. 1.—As it is easily proved, that if a circle rolls in the concave circumference of another whose radius is double, the locus is a straight line, or the epicycloid becomes a straight line, it follows, that when the radius of the generating circle is only half the primitive radius of the pinion, its leaves ought to be straight lines directed to the centre of the pinion.

Cor. 2.—If the pinion drive a rack, the teeth of the rack must evidently be cycloids.

Prop. 3.—If circles be inscribed within the primitives of a wheel and pinion, and concentric with them, and if the acting surfaces of the teeth of the wheel, and of the leaves of the pinion, have the form of the involutes of their respective concentric circles, their motion will be uniform, if a line passing through the point of contact of the two involutes be a tangent to each of the concentric circles.

Let the two circles, (Fig. 13. Pl. 120.) *a f* A and B *c g*, inscribed within the primitives of the wheel and pinion, and concentric with them, have A B drawn as a tangent to each of them at the points A and B. If we suppose the curves *a b* and *c d* formed by the unrolling of A B from the circles B *c g* and A *f a*, it is evident that they touch in D, and that A B will be perpendicular to each of them in that point. If, by the motion of the wheels, they be brought into the positions *f e* and *g h*, the point of contact will, it is evident, still be found in the line A B. Now A D = A *a*, and AC = A F, consequently *f a* = C D. In the same manner *g c* may be proved equal to C D, *i. e.* the wheels pass over equal spaces in equal times, or their angular velocities are equal.

*Formation of epicycloids, &c.*—The simplest mechanical method of forming epicycloids, cycloids, and involutes of circles, seems to be the following, (Fig. 14. and 15. Plate 120.) If an epicycloid be required, let a piece of wood, of which the edge A B is a segment of the base of the epicycloid wanted, be screwed on a plane rectangular portion A E F B, on which is also fixed a piece of brass or tin plate D, as in the figure; and let a thin cylindrical board, of the same diameter as the generating circle, with a nail through it, coming out at the circumference below, be rolled in the direction A B, along the segment A B, the point of the nail being kept firm down on the metalic plate D, in order to trace the curve. The plate is then to be taken off, and the inner part of it cut away with a file; what remains will serve as a model to make the teeth by. The cycloid is to be formed in the same manner, only the generating circle must be rolled along a straight edge.

The *involute*, (Fig. 16. Pl. 120.) is to be traced by moving a ruler on the edge of a circle or segment of a circle of the size of its base, a nail being passed through it and drawn over a metal plate, as in the former case.

It will be necessary that the touching surfaces have chalk or rosin rubbed upon them, to prevent their slipping, or else small sharp metallic pins must be fixed in the bottom of the generating cylinder.

If the generating circle be large, a segment only need be used, as marked by the dotted lines in the figures.

*Of the teeth of bevelled wheels.*—In the case of bevelled or conical wheels, where a part of a fluted cone is made to drive a portion of another fluted cone, in order to change motion in one direction into motion in another, the best curve to give the teeth, in order to produce an uniform motion, is what is called a spherical epicycloid. If the primitive of the pinion P, (Fig. 17. Pl. 120.) roll on the primitive of the wheel W, any point of it will evidently describe a curve similar in its nature to an epicycloid; and as every point of it is equally distant from the apex A of the cone, the curve will be in the surface of a sphere. Hence the name spherical epicycloid.

It may easily be proved, in a manner similar to that in which our first proposition on the teeth of wheels was demonstrated, that if the teeth of the wheel W have the shape of the spherical epicycloid, and drive the pinion P by acting on infinitely small pins in its circumference, the motion produced will be uniform.

What was proved in the second proposition, of the epicycloid, in the case of circular wheels, may likewise be demonstrated of a spherical epicycloid, generated in a similar way, in the case of bevelled wheels.

When bevelled wheels are used, it must always be recollected, that while the teeth at the wider end of the wheel are formed by the epicycloid produced by the rolling of the generating circle on the wide end of the truncated cone, those at the narrower part of the wheel are generated by a circle bearing a like proportion to the inner part of the truncated cone, and rolling on it.

Here we may remark, by the by, that although it is not indispensable that both sides of the teeth of wheels have the same shape, yet as it is sometimes necessary to make machinery move backward as well as forward, it is better to make both faces of the teeth alike.

If it be required to convey, by means of bevelled wheels, motion in any direction, and that the pinion move at the same time at any whatever greater rate than the wheel, the following method may be had recourse to, in order to determine the cones of which the wheels are to be a part. Let A B, (Fig. 18. Pl. 120.) represent the shaft of the wheel; draw through any point of it K the line D C at the given angle, this will represent the shaft of the pinion. Draw F E parallel to D C at any distance, and if the pinion is to revolve three, or four, or five, or any other given number of times, for every revolution of the wheel, draw G H parallel to A B, at three, or four, or five times the distance from it that F E is from C D. Join their intersection I with K, the intersection of A B and C D, which represent the shafts of the wheel and pinion. This line will represent the primitive of the two wheels, as will be evident by inspecting the figure.

In all cases where a part of a machine is to be stopped or *thrown out of geer*, while the rest of it is to be kept at work, bevelled wheels are of the greatest use, because they can be *unlocked* with very great ease. All that is required is to raise one of the shafts a little at one end by a lever. In every instance, however, where this is not required, where the velocity is not to be changed, and where the angle does not exceed 40°, Dr Hooke's universal joint may be substituted. It may be constructed either as seen in the Fig. 19. Pl. 120. or with four pins at right angles on a hoop or solid ball. In cotton mills, where the tumbling shafts are often carried to a considerable distance from the moving power, this invention is found of great use, for it allows the shafts to be cut into convenient lengths. In telescopes, where horizontal and vertical motion are to be communicated by means of endless screws, the rods by which the observer puts the screws in motion are connected with them by means of this joint.

*Method of setting the wheels.*—It is a matter of the very last importance that the teeth of wheels move quite free without incommoding each other. To accomplish this end, it is recommended, in setting off the teeth, to divide the primitive into as many parts as there are teeth required, to divide each of these portions into 16 smaller parts, and allow 7 for the greatest breadth of the teeth, and the remainder for the distance between the teeth. In the case where a wheel drives a lantern, each space should be divided into 7 portions, 3 being taken for the breadth of the teeth, and $3\frac{2}{3}$ for that of the spindle. The height of the teeth ought to be $\frac{2}{3}$ of the pitch or distance between the centre of one tooth and the centre of the next, measured on the primitive. The teeth ought to be rounded off at the extremities. By experience, mechanics have discovered, that when a wheel drives a pinion, the radius ought to be rather greater than what theory teaches; and, on the other hand, the radius of a pinion ought to be greater than what is deduced from theory when it drives a wheel.

As it is a matter of great consequence to know what *pitch* or distance between the centre of one tooth and centre of another, measured on the primitive, wears best, and only to be learned by experience, we have copied the following results from a table in Dr Brewster's *Appendix to Ferguson's Mechanics,* of the pitches of wheels in actual use, with his remarks upon them.

| NATURE OF MACHINERY | Horses Power. | Pitch in Inches. | Breadth of Teeth in ditto | WHEEL. | | | PINION. | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Teeth. | Rev. per Min. | Diameter. | Teeth. | Rev per Min. | Diameter. |
| Water Wheel | $5\frac{1}{2}$ | 3 | 4 | 207 | | $165\frac{1}{4}$ | 50 | | $3.11\frac{5}{8}$ |
| Ditto ditto | 10 | $4\frac{1}{8}$ | $5\frac{1}{2}$ | | | | | | |
| Ditto ditto | 30 | 3 | $10\frac{1}{4}$ | 304 | $3\frac{1}{7}$ | 24 | 3 | 318.47 | |
| Steam Engine | 4 | $2\frac{1}{4}$ | $4\frac{3}{4}$ | 48 | 32 | $210\frac{1}{5}$ | 25 | 61.11 | 1.6 |
| Ditto ditto | 6 | $2\frac{1}{4}$ | $5\frac{1}{4}$ | 60 | 28 | 3.7 | 27 | 626 | $1.7\frac{5}{8}$ |
| Ditto ditto | 10 | $1\frac{7}{8}$ | 6 | 77 | 25 | 3.10 | 40 | 48.5 | $1.11\frac{1}{8}$ |
| Ditto ditto | 10 | $2\frac{1}{4}$ | $5\frac{3}{4}$ | 77 | 25 | $4.7\frac{1}{8}$ | 40 | 55 | $2.4\frac{5}{8}$ |

REMARKS.—1st, At work 16 years. Spur wheel and pinion should have been at least 6 inches wider, as they will not last half so long as the bevel wheels and pinions connected with them.

2d, At work 16 years. Teeth much worn.

3d, At work 16 years. This geering found rather too narrow for the strain, as it is wearing much faster than the other wheels in the same mill.

4th, This wheel has wooden teeth, and has been at work three years.

5th, The same.

6th, This pitch too fine.

7th, This pitch better for the power than the former.

*Of wipers to stampers, &c.*—Intimately connected with this subject, is the proper form to be given to wipers to raise stampers, forge hammers, &c.

If it be required to raise a weight perpendicularly, and at the same time uniformly, by the turning of a wheel, a *wing* of the shape seen in the figure may be made use of. (Fig. 20 Pl. 120.) The method of constructing it is as follows: Divide the arc through which the wheel is to turn, while the weight is raised to the height required, into any number of equal portions G N, N O, &c. (the more numerous the divisions the greater will be the accuracy in drawing the curve.) The height G E is to be divided into a similar number of equal divisions G B, B C, C D, D E. Through the points N, O, Q, M, draw the lines A H, A I, A K, and A L, equal respectively to A B, A C, A D, and A E. From C, trace with the hand a curve through the points H, I, K, and L. This is the form to be given to the wing in order to raise the weight uniformly through G E.

That a wiper of this form would produce the desired effect is evident, for the arcs G N, N O, &c. are all equal; and when the point N comes to G, the point H carrying the stamper along with it will be in B, because A H and A B are equal. For the same reason, when O is in G, L will be in C, when Q is in G, K will be in D, and M being in G, the stamper will have risen with L to E. It is easy to see that a number of wipers might be attached to the same wheel.

If an uniformly accelerated or retarded motion be required, G E must be divided in the given ratio, and the lines A H, A I, &c. as before, made equal to A B, A C, &c.

In the case of a forge-hammer, an accelerated motion is necessary, in order that the hammer may rise above the height to which the mere action of the wiper would carry it, impinge against an oaken spring, and thus fall with the greater force upon the anvil.

### 3. *Of the Pulley.*

The third mechanical power of which we proposed to treat was the pulley. The pulley is a wheel moving on an axle; it has usually a groove cut in its circumference in order to receive the rope which is passed round it, at the opposite end of which the power and the weight act. A pulley is said to be fixed or moveable according as the block which contains it is fixed or moveable.

If the pulley be fixed, it gives no mechanical advantage; it merely changes the direction of the power applied. Thus, the power P and the weight W (Fig. 21. Pl. 120.) will, if equal, balance one another, as they are acting at the opposite ends of a lever with equal arms. If, however, the pulley be moveable, a power will sustain a weight double of itself; for the ropes AE and C B (Fig. 22. Plate 120.) sustain the weight W betwixt them; wherefore the rope A E sustains only half the weight, or a power $P = \frac{1}{2}W$ will balance W. The pulley at A only serves to change the direction of the power.

Hence, abstracting from friction, &c. the advantage gained by making use of a system of pulleys is equal to the number of ropes by which the weight is suspended. As a system of pulleys, when formed by a number of sheaves placed below each other in long blocks, take up a considerable deal of room, the general practice is to place the sheaves in separate divisions, in thick blocks, making one pin to serve as an axle for them all. When, however, there are a number of pulleys in the same block, the rope to which the power is applied is usually made to pass over one of the outside sheaves. This causes the block to hang out of the perpendicular, and produces an immense friction of the pulleys against the sides of the block. Mr Smeaton got rid of this inconvenience by making the rope to terminate over the middle pulley. By this contrivance, all friction, except at the centres of the pulleys, is done away with. This improvement requires the number of sheaves in the fixed block to be always uneven.

We have given a representation of another improvement on the pulley by Mr J. White, for which he has received a patent. A and B (Fig. 23. Pl. 120.) are two pulleys, one fixed and the other moveable; each of them has six concentric grooves cut in them, of different radii, and capable of receiving a rope round them. They act in the same manner as if they were separate pulleys of which the diameters were equal to those of the grooves. The advantages of this method are, that it removes all lateral friction, and the shaking motion, which commonly attends a combination of pulleys.

A method of diminishing the friction of pulleys upon their axis has lately been hit on by Mr John Gamett. It consists in interposing six or more cylindrical rollers between the internal cavity of the pulley and its axis. The ends of the rollers turn in large holes made in flat rings of iron or brass. When a set of pulleys of this construction is used, it is found that three men can raise as much as five men can by a set of the common construction.

### 4. *Of the Inclined Plane.*

Prop.—A body descending along an inclined plane will be kept in equilibrio if the power be to the weight as the height of the plane to its length.

The force with which a body D, (Fig. 24. Pl. 120.) descends along an inclined plane, C B, is that of gravity alone. Now, part of this must be destroyed by the reaction of the plane, and it will be impelled only by part of this force. Thus, if D F represent the force of gravity, it may be resolved into the two sides D G and D E of the parallelogram D E F G, the one parallel and the other perpendicular to the inclined plane. D E is destroyed by the reaction of the plane, and the body is therefore carried along by D G only; therefore, a power equal to D G will sustain it. But the triangles A B C and D F G are similar, being right angles at A and G; and the angle C D F being equal to D F E, is, from the property of parallel lines, equal to A C D; wherefore, F D : D G :: C B : C A: that is, the whole weight of the body is to the power which sustains it in the plane as the length B C of the plane to its height A C.

When a carriage ascends a hill, a certain proportion must be added to the draught on level ground, according to the nature of the declivity. Suppose, for instance, that the carriage is ascending a hill which rises one foot in four, then a fourth of the force which is necessary to move it on level ground must be added to obtain the power necessary to drag it up the declivity.

### 5. *Of the Wedge.*

The wedge is a triangular prism of wood, metal, or other firm material. It may be regarded as composed of two inclined planes laid back to back.

Prop.—If three forces be applied perpendicularly to the back and sides of a wedge, equilibrium will take place if they meet in the same point and are proportional to the length of the planes to which they are applied.

Let E D, F D, and G D (Fig. 6. Pl. 121.) represent these forces acting perpendicularly on the three faces of the triangular prism or wedge A B C, and meeting in the point D; if they keep the wedge in equilibrio, they are proportional to the sides of the triangle to which they are applied. For, produce F D to meet B C in H; draw I H K parallel to E D, which will evidently meet G D produced in some point K. The sides of the triangle H D K thus formed are (Prop. 3. Sect. II. Part I.) proportional to the forces E D, F D, and G D, being parallel to them, or in the same direction with them. But the triangle H K D is similar to A B C; for the angle H D G is equal to the angle H C F. Again, the angle at K is equal to the angle at B; because the two triangles G H K and B I H are also similar. Wherefore, the whole triangle H D K is similar to A B C. Therefore, &c.

Cor.—Hence, if an isosceles wedge, A B C, (Fig. 7. Pl. 121.) be let into a cleft, and an equilibrium subsist, the force acting on A C is equal to the resistance on A B together with that on C B; or the resistance on each side being equal, the force applied on A C is equal to twice the resistance on A B; that is, the pressure is to the resistance as the breadth of the back of the wedge is to twice the length of one of the sides, or as half the breadth of the back to the length of one of the sides. The efficacy of the wedge is therefore increased by diminishing the breadth of the back, and lengthening its sides.

In cleaving materials, the force which acts with greatest efficacy on the wedge is percussion. A much superior effect is produced in this way than can be brought about by pressure, the momenta of the forces being the same. This seems to arise from the vibrations excited by the blows lessening the power of cohesion among the particles of the body, and at the same time diminishing the friction on the sides of the wedge.

The wedge may be employed with great advantage where the other mechanical powers would be quite useless; as for propping the walls of houses, splitting rocks, and raising up the heaviest ships. To this power are to be referred all pressing and cutting instruments, as nails, stakes, bayonets, knives, chissels, scissars, &c. The saw is a series of wedges, to which the power is applied obliquely.

In the case of bridges we have an instance of the wedge made use of for the purpose of equilibrium, an arch consisting of a number of truncated wedges.

*Fig. 1.*

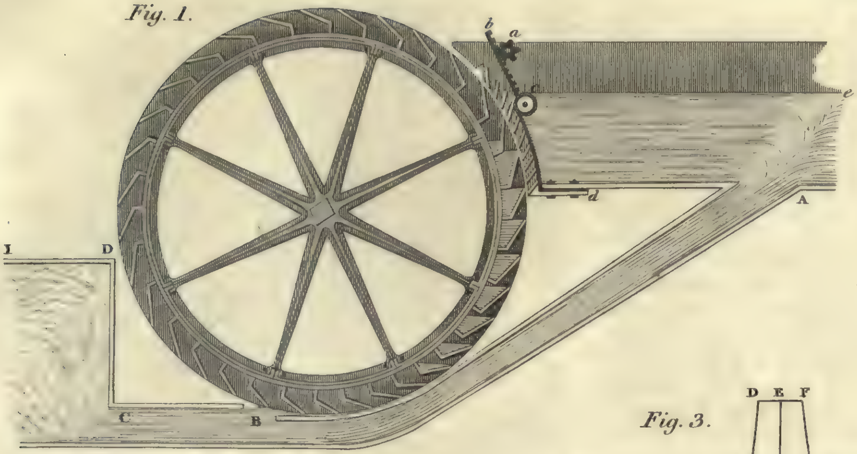


*Fig. 2. No. 1.*

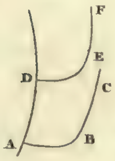


*Fig. 2. No. 2.*

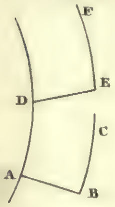


*Fig. 3.*

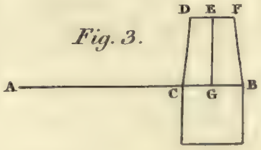


*Fig. 5.*

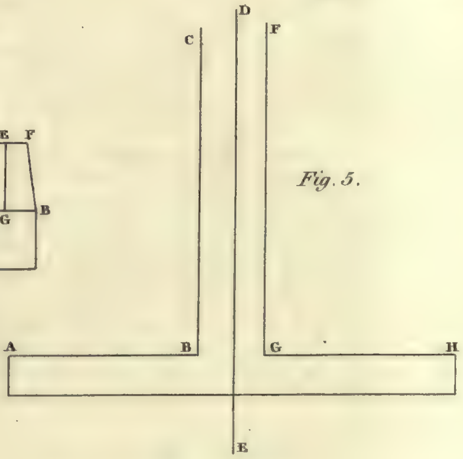


*Fig. 4.*

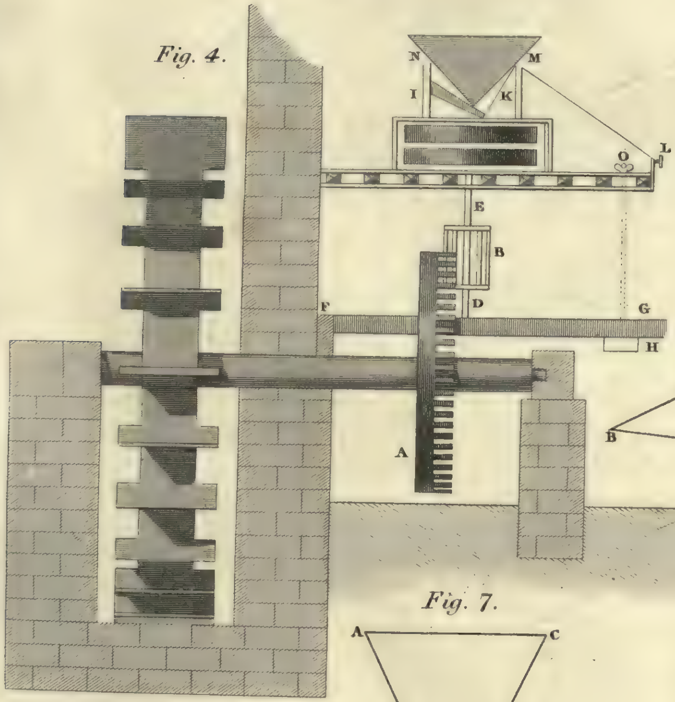


*Fig. 6.*

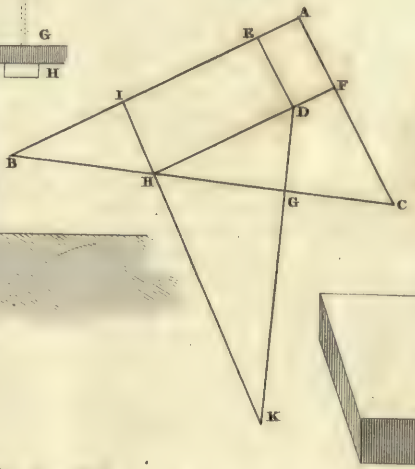


*Fig. 8.*

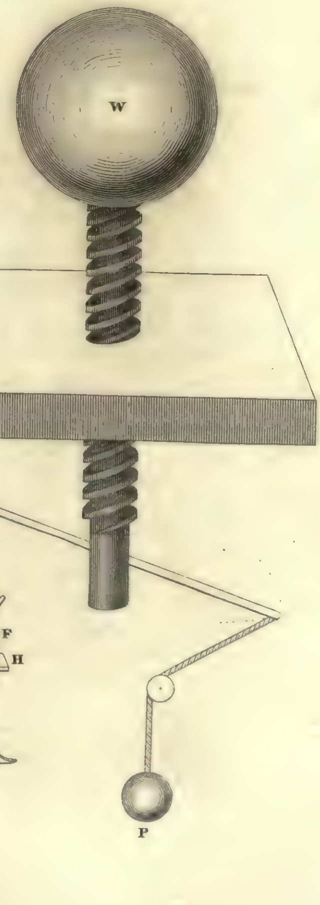


*Fig. 7.*

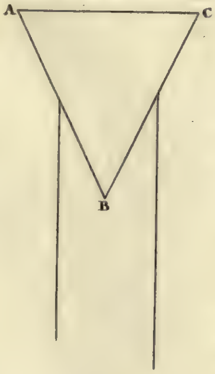


*Fig. 9.*

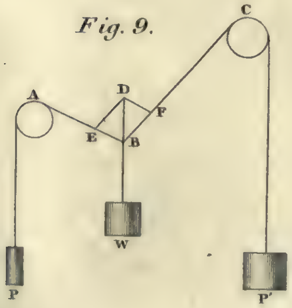


*Fig. 10. No. 2.*

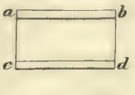


*Fig. 10. No. 3.*

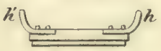
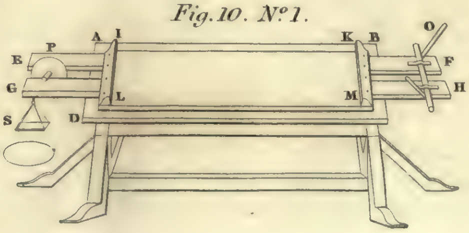


*Fig. 10. No. 1.*



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### 6. *Of the Screw.*

A screw is a cylinder of wood, metal, or other firm material, having a spiral groove cut in it, or spiral thread raised on it, making equal angles to every line on the surface of the cylinder drawn parallel to the axis. The screw is said to be internal or external, according as the spiral winds round the concave or convex surface of the cylinder. When an *external* screw works in an *internal* screw, they form a machine of great power for moving or compressing bodies.

Prop.—In the screw an equilibrium will take place if the power acting parallel to the base of the instrument, and perpendicular to the radius to which it is applied, be to the weight pressing perpendicularly on the axis of the screw as the distance between the spirals is to the length of the lever on which the power acts.

For while the power P, (Fig. 8, Pl. 121.) makes a complete revolution, the weight W has only been raised by a space equal to the interval between two of the threads, and the velocity of the power is to that of the weight as a whole revolution to the breadth of the groove; consequently, forces which are inversely as these velocities will balance each other. The same result will be obtained by considering the screw as an inclined plane wrapped round a cylinder. In the screw a great deal of friction takes place, yet here it is not without its use; for it serves to maintain the instrument in its place, and to keep up the effect which has been produced, even after the generating power has been removed.

Among the many useful purposes to which the screw may be applied, we must not omit to mention that of dividing or measuring small spaces. When applied to this purpose it is called the *micrometer screw.*

A screw is sometimes made to turn a toothed wheel, and then it is called an endless screw. In the common jack, the fly is put in motion by a toothed wheel acting on a double screw.

### *Funicular or Rope Machine.*

A distinct idea of the way in which this power operates may be had by observing the way in which a sail, after being hoisted almost as high as it can be, through means of the block and tackle alone, is brought into its right place. The rope is passed under a cleat and held fast; a man then lays hold of it above the cleat, and pulls it to him in a horizontal direction; and in this manner the sail is hauled *taught up,* in the language of seamen. Thus we see it to be a power quite different from the pulley.

Prop.—If a body W, (Fig. 9. Pl. 121.) be sustained by the weight P and $P'$ attached to the two ropes B A and B C passing over the fixed pulleys A and C, P will be to $P'$ inversely as the sines of the angles which their directions make with that of the weight, that is, as the sine of C B W to that of A B W, or what is the same thing as the sines of their supplements C B D and A B D.

For, suppose the force sustaining W or B to be represented by B D, and complete the parallelogram B E D F. The force sustaining W on the side C will be represented by E D, and that on the other side by D F. Hence we shall have P : W : : D F or E B : B D; but by trigonometry E B : B : : sin. E B D (= sin. D B F,) : sin. D E B, or what is the same thing, A E D or E B F = the supplement of D E B. In the same manner it may be shewn that $P'$ : W : : sin. D B E : sin. F B E; that is, since W and sin. E B F consequents in both analogies, P : $P'$ : : sin. D B F : sin. B D E. Cor.—Hence P + $P'$ is to W as sin. A B D + sin. C B D to sin. A B C.

If the weight be sustained by more than two ropes, by the composition of forces they may always be reduced to two.

By means of this instrument, a small power may be made to raise a great weight through a small space; for the point B must be depressed a considerable way before the sine of A B C approach to an equality with the sum of the sines of A B D and D B C.

The gravity of a rope or chain, when stretched horizontally between two points, prevents it from being ever made perfectly level. The curve which a cord or chain, when hung by its two ends from points at some distance from each other naturally assumes, is called a *catenarian curve.* It has been recommended as a curve very suitable to form bridges by. The form which it will take when weights are hung from it at different points, will shew the curve which ought to be given to the arch when it is to be loaded in a similar manner.

## SECT. II. *Of the Strength of Materials.*

As some very good observations on the strength of materials, when subjected to different strains, will be found in the article ARCHITECTURE, p. 397, *et seq.* at this time we shall merely give some tables of the cohesive forces of different substances, selected from different authors, and which will be found of great use to the practical mechanic.

1*st, Cohesive force of different Woods pulled in the direction of their lengths.*—This and the following table are from Mr Thomas Tredgold's Treatise on Carpentry.

| Woods. | Cohesive force of the square inch in pounds. | Experimentalists. |
|---|---|---|
| Oak - | 17·300 | Muschenbroek. |
| Ditto - | 13·950 | Rondelet. |
| Ditto dry English from | 12·000 | Barlow. |
| to - | 8·889 | |
| Ditto - | 7·850 | Anderson. |
| Ditto - | 6·114 | Emerson. |
| Beech - | 17·709 | Muschenbroek. |
| Ditto - | 11·500 | Barlow. |
| Ditto - | 6·300 | Anderson. |
| Ditto - | 6·070 | Emerson. |
| Alder - | 14·186 | Muschenbroek. |
| Ditto - | 5.094 | Anderson. |
| Ditto - | 4·290 | Emerson. |
| Sycamore - | 5·000 | Ditto. |
| Span. Chesnut - | 13·300 | Rondelet. |
| Ash from | 17·850 | Barlow. |
| to - | 15·784 | |
| Ditto - | 12·000 | Muschenbroek. |
| Ditto - | 16·300 | Anderson. |
| Ditto - | 6·070 | Emerson. |

| Woods. | | Cohesive force of the square inch in pounds. | Experimentalists. |
|---|---|---|---|
| Elm | | 13·489 | Muschenbroek. |
| Ditto | | 6·070 | Emerson. |
| Ditto | | 4·455 | Anderson. |
| Acacia | | 20·582 | Muschenbroek. |
| Mahogany | | 8·000 | Barlow. |
| Walnut | | 8·130 | Muschenbroek. |
| Ditto | | 5·360 | Barlow. |
| Poplar | from | 6·641 | Muschenbroek. |
| | to | 4·596 | |
| Fir | from | 13·448 | Barlow. |
| | to | 11·000 | |
| Ditto | | 8·506 | Muschenbroek. |
| Ditto | | 5·000 | Emerson. |
| Pitch pine | | 7·818 | Muschenbroek. |
| Norway pine | | 7.287 | Rondelet. |
| Larch | | 10·220 | Ditto. |
| Cedar | | 4·973 | Muschenbroek. |

*2d, Cohesive force of a Square Inch pulled asunder in a direction perpendicular to the length of the fibre.*

| Woods. | | Pounds. | |
|---|---|---|---|
| Oak, | | 2·316 | Mr Tredgold. |
| Poplar, | | 1·782 | |
| Larch | from | ·970 | |
| | to | 1·700 | |

*3d, Cohesive Force of a Square Inch of different Metals.*

| Metals. | | Pounds. |
|---|---|---|
| Gold cast | from | 20,000 |
| | to | 24,000 |
| Silver cast | from | 40,000 |
| | to | 43,000 |
| Copper cast | Japan, | 19.500 |
| | Barbary, | 22,000 |
| | Hungary, | 31,000 |
| | Anglesia, | 34,000 |
| | Sweden, | 37,000 |
| Iron cast | from | 42,000 |
| | to | 59,000 |
| Iron bar | Ordinary, | 68,000 |
| | Stirian, | 75,000 |
| | Best Swedish and Russian, | 84,000 |
| | Horse nails, | 71,000 |
| Steel bar | Soft, | 120,000 |
| | Razor temper, | 150,000 |
| Tin cast | Malacca, | 3,100 |
| | Banca, | 3,600 |
| | Block, | 3,800 |
| | English block, | 5,200 |
| | ——— grain, | 6,500 |
| Lead cast, | | 860 |
| Regulus of Antimony, | | 1,000 |
| Zinc, | | 2,600 |
| Bismuth, | | 2,900 |

*4th, Cohesive Force of Mixtures of different Metals.*

| | Pounds. |
|---|---|
| Two parts of gold with one of silver, | 28,000 |
| Five parts of gold with one of copper, | 50,000 |
| Five parts of silver with one of copper, | 48,500 |
| Four parts of silver with one of tin, | 41,000 |
| Six parts of copper with one of tin, | 41,000 |
| Five parts of Japan copper with one of Banca tin, | 57,000 |
| Six parts of Chili copper with one of Malacca tin, | 60,000 |
| Six parts of Swedish copper with one of Malacca tin | 60,000 |
| Brass consists of copper and zinc in an unknown proportion, its cohesion is | 51,000 |
| Three parts of block tin with one part of lead, | 10,200 |
| Eight parts of block tin with one part of zinc, | 10,000 |
| Four parts of Malacca tin with one part of regulus of antimony, | 12,000 |
| Eight parts of lead with one of zinc, | 4,500 |
| Four parts of tin with one of lead and one of zinc, | 13,000 |

These two last tables are the same as two given in Dr Robison's *Mechanical Philosophy*, Vol. I. p. 398 and 399. It would appear from them, that mixed metals are much stronger than simple metals. The tenacity of the compound varies according to the proportion which the ingredients bear to each other. The proportions here given are those which the experiments of Muschenbroek shew to be productive of the greatest strength.

These mixtures are of great use in the arts. Thus, by compounding copper, the strength of which does not exceed 37,000 with tin, which is about 6000, we produce a metal of almost double tenacity, and which is at the same time harder and more easily wrought. A small addition also of zinc almost doubles the strength of tin and increases that of lead five times; and a small quantity of lead doubles the strength of tin. These facts are well worth the attention of plumbers, &c.

### Sect. III. *Of Friction.*

*Definition.*—By friction in mechanics we understand the impediment occasioned to motion when one surface rubs on another. Friction seems to be owing to the unevenness which exists on the surfaces of all bodies even when most highly polished. When the eminences of the one body sink into the cavities of the other, all motion will be prevented, until a force be exerted capable to disengage them, either by causing the eminences of the one body to rise out of the cavities of the other, or by levelling down the opposing asperities.

The adhesive force which exists among the particles in contact, no doubt, tends likewise to increase friction, since it is not always diminished by the high polish given to the rubbing surfaces.

The immense loss occasioned to generating forces in all kinds of machinery from friction, renders a complete knowledge of its laws, and of the methods of diminishing it, a matter of great consequence to all interested in mechanical investigations.

Two very simple methods of measuring the friction of the surfaces of bodies on each other have suggested themselves to philosophers. One by applying such a power to a body placed on a horizontal plane, that it may be ready to move on the least addition to that power; the other, by placing a body on a plane, and elevating it to such an angle that the body may just begin to slide.

Although much has been done by philosophers, both experimentally and theoretically, to investigate the nature of friction, success has by no means been commensurate with the trouble they have taken. Their researches, however, are far from having been altogether vain. The following are some of the very important results which have been deduced from their experimental labours.

The more intense the pressure is, and the rougher the surfaces of bodies are, the greater will be their friction; but *caeteris paribus*, it does not seem to be much influenced by the extent of the surfaces; at least (though in some instances there appear to be exceptions to this last observation) for all practical purposes, the ratio of the friction to the pressure may be regarded as constant.

When motion commences, the intensity of friction diminishes. Coulomb, to whom the mechanical and philosophical world are so much indebted for his valuable researches on this subject, found that, in some cases, as in wood sliding on wood, friction was lessened in the ratio of five to nine as the body began to move. It does not, however, change with the velocity, but seems to remain nearly uniform for all velocities; for in Coulomb's experiments, which were conducted on a great scale, and with much accuracy, and therefore to be depended on, it was found that bodies made to move on a horizontal plane with a constant force were uniformly accelerated; and it is demonstrable, that this could not have taken place if the resisting force had not been uniform as well as the moving power.

In some instances friction does not attain its maximum for a considerable period; in others, time makes no alteration on the intensity of the friction. When the bodies were of the same kind, Coulomb found that friction came to its maximum in a comparatively short time. In wood sliding on wood, for instance, little more than a minute or two was necessary. In metal sliding on metal, friction seemed to come to its height almost instantaneously. But when bodies of different kinds were made to slide over each other, friction did not reach its limit for four or five days.

Contrary to what might naturally have been expected, when wood was dragged over wood across the fibres, the friction was less than when it was dragged in the direction of the fibres. Oak, for instance, rubbing against oak in the direction of the fibres had a friction of $\frac{1}{2.34}$ of the pressure; when the motion was across the fibres, it did not amount to more than $\frac{1}{3.76}$.

When a metallic surface moves on a surface of the same kind of metal, the friction is greater than when it moves on a different kind of metal. When iron moves on iron the friction is about $\frac{1}{3.6}$ of the whole pressure. This is owing, perhaps, to the superior attraction which the same kinds of metals have for each other. But, from whatever cause it may arise, we are enabled to draw this conclusion from the fact, that when the axles of pinions or wheels are made of iron, the bushes ought to be of brass or bell metal. It also shews us the propriety of making the pinions of clocks and delicate machines of steel when the wheels are of brass.

Coulomb found, that when iron moved over oak, the motion being extremely slow, the friction only amounted to about $\frac{1}{13}$ of the pressures; but, in this case, as the velocities increased nearly in a geometrical progression, the friction was found to follow nearly an arithmetical progression.

Friction is greatly diminished by the interposition of fatty bodies, such as tallow, hogslard, oil, &c. between the rubbing surfaces. The time required for friction coming to its height is longer when such substances are made use of, more especially if they are tenacious in their nature. Indeed, when so thin a substance as olive-oil is employed, little alteration in this respect is observed.

But these substances, when made use of for diminishing friction, must be often renewed; for otherwise, by becoming thick, they tend to increase it in a very great degree.

When the surfaces in contact are of wood, tallow or swine's grease are to be preferred as unguents; when of metal, oil should be employed. If the pressure be very great, tallow diminishes friction more than hogslard. When wood moves on metal, tallow should be made use of. It is recommended, when unguents are applied, merely to rub the surfaces, so that a thin stratum only may be left on them; for then the friction will be a constant quantity, and will not increase with the velocity. Plumbago or black-lead, as it is called, reduced to powder, and rubbed on the surfaces of bodies, tends greatly to lessen friction. The way in which all these substances act in diminishing friction seems to be by filling up the cavities of the surfaces to which they are applied.

From a number of experiments on the friction of the axis of pulleys, the following results were obtained by M. Coulomb:—

An iron axle, moving in a bush of brass, without grease, had a friction of about $\frac{1}{6}$ of the pressure.

When clean tallow was interposed the friction was reduced to - - - $\frac{1}{11}$
When hogslard was used it was about - $\frac{1}{8}$
olive-oil - - - $\frac{1}{7}$
When the axis was of holm oak and the bush of lignumvitae, the friction was - $\frac{1}{26.3}$
When the tallow was removed, so that the surface only remained greasy, it amounted to - - - - $\frac{1}{16.7}$
When the bush was of elm, the friction, in similar circumstances, was $\frac{1}{33.3}$ and $\frac{1}{20}$
When the axis was of box and the bush of lignumvitae, the friction, in similar circumstances, was - - $\frac{1}{23}$ and $\frac{1}{14.3}$
When the axis was of box and the bush of elm, in similar circumstances, the friction was - - - $\frac{1}{28.6}$ and $\frac{1}{20}$
Axis of iron and bush of lignumvitae, the tallow being wiped off, and the pulley turned for some time, the friction was $\frac{1}{20}$
of the pressure,

The friction of rolling bodies is much less than that of sliding bodies. This most probably arises from the eminences of the one body being lifted out of the cavities of the other, instead of the asperities of the one being forcibly impelled against those of the other. It is, therefore, always of very great advantage, whenever it is practicable, to substitute rolling friction for sliding friction. In the case of axles this is often effected by means of what are called friction-wheels. These are merely two small wheels moving on in the same plane, and nearly touching each other, betwixt which the axle of the large wheel is made to turn instead of in a groove. By this contrivance the momentum of friction is lessened, by being transferred from the circumference of those wheels to their pivots. The change from sliding to rolling friction would here be complete, if, instead of turning on a fixed axis, the friction wheels were cylinders reasling freely.

When an axle is of iron the friction wheels should be of brass, and *vice versa.*

The wheels of carriages are likewise a contrivance intended to convert a sliding into a rolling friction. In this instance, however, the change is not complete, for the friction at the axle is still that of sliding; but being transferred from the circumference of the wheel (where it would act if the wheel did not revolve) to the circumference of the axis, it is diminished in the ratio of the radius of the axle to that of the wheel. Of course, in this case, the momentum of friction will always be diminished by increasing the radius of the wheel and lessening that of the axis. Axles or gudgeons ought always to be formed as small and short as possible; a gudgeon two inches in diameter will support a weight of 3239 lbs. Avoirdupois. In the case of an upright axis, the pivot ought to be convex. It is the practice of many artisans, in forming an axle for carriages, to give the ends a set forward, by which the distances between the rims before is made about an inch less than it is behind. The absurdity of such a fashion, and its effect in increasing friction, needs no comment. We never, indeed, heard a shadow of a reason urged in defence of the plan. It seems now happily to be rather going out of use. Good roads tend to diminish friction in the case of wheel carriages. In all instances, therefore, where loads are to be transported, wheels with broad rims should be used, since they are much more favourable to roads than narrow wheels, the pressure being spread over a greater portion of the road, and consequently the materials of which it is composed are not so apt to be brayed down.

In delicate machinery, the best substance for supporting pivots is *garnet.* In pivots, Coulomb found that the friction depended on the pressures rather than on the velocities. When the pivots are acute, and fit into a cup of garnet, agate, &c. the angle should not be too small, otherwise the friction is greatly increased. When the pressure is five or six eights of an ounce, the least angle is from 30° to 40°. As it becomes lighter, the angle may be diminished progressively without inconvenience.

There is a considerable analogy between the friction of surfaces and the *stiffness of ropes.* From a variety of experiments on this subject, Coulomb estimated that, *cæteris paribus,* the stiffness of ropes followed the ratio of the squares of the diameter. It is also found to be inversely as the ratio of the cylinders round which they are wound. When a rope is passed round a roller, the friction is found to increase in geometrical progression, while the number of turns follow an arithmetical progression; that is, if the turns be 1, 2, 3, 4, &c. the friction will be represented by the numbers 1, 2, 4, 8, 16, &c. Hence it is that resistance of this kind is so useful in retarding motion, as in stopping the way of vessels, &c.

" Though friction" to use the words of Mr Playfair, " destroys motion and generates none, it is of essential use in mechanics." " A nail, a screw, or a bolt, could give no firmness to the parts of a machine or of any other structure without friction. Animals could not walk, or exert their force anyhow, without the support which it affords. Nothing would have any stability but in the lowest possible situation; and an arch which could sustain the greatest load, if properly distributed, might be thrown down by the weight of a single ounce, if not placed with mathematical exactness at the very point which it ought to occupy.

" By means of friction plates of metal are extended, wire, pipes, &c. lengthened," &c. &c.

On the subject of friction, consult *Muschenbroeck,* Sect. 510--533; Dr Brewster's *Appendix to Ferguson's Mechanics,* Vol. II. p. 148; Playfair's *Outlines,* &c. For a full account of Coulomb's experiments, see *Journal de Physique* for September and October 1785, as also in *Memoires de Savans Etrangers,* Tom. X. p. 163.

### SECT. IV. *On the Strength of Men and Animals as the first movers in Machinery.*

As the strength of men is of such extensive use as a first mover, and, indeed, not to be superseded by any other in operations of various descriptions, from the intelligence necessary to conduct them, it is a matter of very great consequence to masters as well as to workmen, to discover how it may be employed to greatest advantage, and husbanded so as that the greatest quantity of work may be realized with the least degree of fatigue.

Daniel Bernouilli was of opinion that bodily fatigue was always proportional to the quantity of work done, whether a man were employed in walking or in carrying a load, or in drawing or in pushing. The fallacy of this doctrine was, however, completely evinced by the labours and investigations of that patient experimentalist M. Coulomb.

It is to M. Coulomb, indeed, that we are indebted for by far the greater part of the useful information that we are possessed of on this subject. We shall set down here a few of the most important results which have been obtained from his labours, as well as from those of other philosophers in this department. Coulomb found, that in general the quantity of work which men performed was proportional to their weight, provided this weight did not arise from corpulency, disease, &c.

Supposing the average weight of a man to be 150 pounds Avoirdupois, and that he can walk at the rate of 31 miles per day, and continue to do so any given number of days, which he may effect without difficulty, we may reckon the work done equivalent to his having carried 150 lbs. 31 miles;—that is, 7700 lbs. Avoirdupois, carried 1094 yards (= a French *kilometer,*) or 3281 feet, including the man's weight.

Three hundred lbs. is about just as much as a man of moderate force is able to carry. Yet it is said that a man standing upright can bear what would break the back of a horse, because the weight presses directly on the column of the bones in the man, whereas it is laid across that of the horse. The more a man bends forward the less is he able to bear. Two men can carry between them more than double what each of them could carry separately, because they can move with the column of their bones more directly under it. Chairmen carry 150 lbs. each, and move at the rate of four miles an hour. A porter will carry 180 lbs. and walk at the rate of three miles an hour. Coal-heavers sometimes carry 250 lbs. but then they only go a short way with their burden.

When a man travels loaded with a burden of 130 lbs. the *useful* effect is computed by Coulomb to be about 2012 lbs. carried 1094 yards. When he goes loaded with 130 lbs. and returns for another burden, the *useful* effect is estimated about 1530 lbs. carried 1094 yards.

When a man, unloaded, and moving at his utmost speed, ascends a staircase, the total or mechanical effect is about 454 lbs. raised 1094 yards. Although the strength of a horse be estimated equal to that of five men, the human form is so much better adapted for climbing than that of an horse, that three men will carry more up a steep hill than a horse. Each of them bearing 100 lbs. will ascend faster than a horse loaded with 300 lbs.

According to the estimate of Dr Desaguliers, a man of ordinary strength can turn a winch for ten hours with a force equal to 30 lbs. at the velocity of 2½ feet per second. If a fly be added to the windlas, and the motion be so quick as four or five feet per second, he may work a whole day against 40 lbs. and for a short time he may exert a force of 80 lbs. The advantage obtained from the employment of the fly does not arise from any virtue or power in the fly itself, as many imagine, but from the momentum or force which becomes accumulated in it. Flys are often used as regulators of the motion of machines; in that case they ought to be placed as near the moving power as possible. When, as here, a fly is intended to act as a reservoir of force, it ought to be placed near the *working-point,* so as to move with a rapidity about equal to it. Fly-wheels are usually made of iron; they ought to be smooth, and contrived so as to present as little resisting surface to the air as possible. It is indeed reckoned, that if a man of 140 lbs. weight could exert his force without intermission, and always in the direction of a tangent to the circle described by the winch, he might raise 84¾ lbs.; for the forces which he is able to exert may be estimated as follows: At the lowest point, to above his knees, where he is able to exert his whole strength, a force equal to 160 lbs.; at the weakest point, where he thrusts it from him in a horizontal direction, a force of 27 lbs.; at the point opposite to him, where he thrusts it down with his weight, a force of 130 lbs.; and at the last point, where he begins to draw it in a horizontal direction towards him, 30 lbs. These added together, and divided by 4, give the result above-mentioned.

From what has been said, it must be evident, that if a windlas is to be provided with two handles they ought to be placed at right angles to each other; for in this case the workmen will be able to assist each other most effectually at the weak points.

The mechanical object of turning a winch has been estimated at 256 lbs. raised 1094 yards; that of pumping 419 lbs. raised 1094 yards; that of ringing 572 lbs. raised 1094 yards; that of rowing 608 lbs. raised 1094 yards. When a man raises a weight by means of a pulley, the useful effect is about 88·3 lbs. raised 1094 yards. Some have estimated the effect produced in this way even as high as 165 lbs. M. Glamandi's result is 106; it is deduced from the work done by 38 men raising a weight to drive piles. When a man digs with a spade, the effect is equal to about 221 or 222 lbs. raised 1094 yards. By carrying a load on a wheel-barrow, a man will produce an effect as great as 2257 lbs. raised 1094 yards.

*Strength of animals.*—The strength of an ass is reckoned to be equal to that of two men. A horse is by some estimated to be as powerful as five men, by others as seven; Schultz makes him as strong as 14. According to Cazand, a mule in the West Indies works two hours out of the eighteen with a force equal to 150 lbs.

A horse, according to Desaguliers, can draw with a force of 200 lbs. for eight hours, and move at the rate of 2½ miles an hour. The same author says, that a horse can draw up a hill more than three men can carry, *i. e.* from 450 to 750 lbs. He tells us also, that a strong horse can draw 2000 lbs. up a steep hill which is not long. When a horse is to work in a walk, as in working a gin, &c. care should be taken that the walk be made sufficiently wide. It should never be less than 40 feet. Three men can give motion to a horizontal beam in a 19 feet walk with as much ease as a horse. In a 40 feet walk a horse can do as much work as five men. The reason of this is, that, in the small circle, the tangent at which he works deviates so much from the circle that he is incapable of fully exerting his strength.

A horse travelling on good roads can carry 200 lbs. 25 miles in seven or eight hours. According to Dr Desaguliers, a horse has sometimes carried 650 or 700 lbs. as its ordinary work, seven or eight miles. He tells us likewise, that a horse at Stonebridge carried 1232 lbs. for eight miles.

## SECT. V.—*Description of various useful Machines.*

*Coulomb's Machine for ascertaining the friction of bodies.*—This machine is represented at Fig. 10. No. 1. Pl.121. It consists of a firm wooden table, A B C D, supported on very strong legs. The top of the table is formed of a solid plank eight feet long, two feet broad, and three inches thick. In the direction of its length are laid two strong oaken planks, E F and G H, 12 feet long, eight inches thick, and three inches apart. Another plank, I K M L, carefully planed, is firmly fixed upon these two pieces. Its dimensions are eight feet in length, 16 inches in breadth, and three inches in thickness. Along this, sledges of the shape Nos. 2. and 3. are made to slide. This is effected by means of a rope made fast to one of the hooks *h* passed over the pulley and attached to the scale S, which may be loaded with weights to any amount. The scale descends into the pit Q four feet deep, immediately under the pulley P. The sledges may be drawn back by a rope attached to the hook *h'*, and fixed to the small windlas at O. On the bottom of the sledges are nailed two small pieces of wood, *a b* and *c d*, so as to guide them when placed upon the plank I K M L. A play of two or three lines is allowed the sledge, in order that it may not be obstructed in its passage along the plank. When it is wished to diminish the touching surfaces, pieces of wood, &c. of different breadths are nailed on the bottom of the sledges, their ends being rounded off for securing the nuts, in order that they may not act on the plank I K M L. The pulley P is made of very hard wood, is one foot in diameter, and weighs 14 lbs. It turns on an axis of green oak 10 lines in diameter.

A *Crane* is a machine employed for raising or lowering heavy weights. This name is apparently given it from the long neck or gib, which is one of its most necessary parts. Cranes are of great use at quays and wharfs, in building, at warehouses, &c.

It was formerly the practice to have the working part of a crane separate from the gib. This was attended with many inconveniences. In particular, from the complication of its parts, it was more liable to go wrong. Unless the rope proceeded in a direct line from the capstan or barrel over the point of the gib, by pressing on the directing rollers, it occasioned a great deal of resistance; and it required a considerable force to keep the gib in the proper position. For these and other reasons, it has therefore come to be the custom to attach the working part of a crane to the gib; and, when constructed of cast iron, it has been found that, in this way, they may be made sufficiently powerful for any purpose. There are two at the Wet Docks at Leith erected by the late Mr Rennie, and warranted to raise 12 tons.

The crane represented in Pl. 122. Fig. 1. is an improved cast-iron one, the manufacture of the Shotts Iron Company. It is a very neat machine, and will be found quite adequate for all ordinary purposes. There have been a good many of them erected in the country, and they are, we understand, coming into general use in the sugar plantations.

The crane is wrought by means of the winch E attached to the pinion A, which, by the lifting of a catch from its axle, may be made to slide endwise and so work either in the wheel B or D, according as a greater or less power is required. By turning the winch E one way or other, the rope F F, which passes over the pulley P, is taken on to the capstan *c*, or let off from it, and so the weight W is raised or depressed. If we follow the estimate of Dr Desaguliers, and suppose that a man, by the winch E fixed on the axis of the capstan *c*, could raise 40 lbs., by turning the winch E fixed to the pinion A, and working in the wheel B, he will be able to raise 288 lbs.; for the pinion bears to the wheel a ratio of 10 to 72, and 40 multiplied by the tenth of 72 gives 288 for the product. By making use of the greater power, that is, by making the pinion A to work in the wheel D, he would be enabled to raise about 9800 lbs.; for B bears to D a proportion of 10 to 36, and puts B in motion by means of a pinion equal in size to A. Of course there is another winch at the other end of the axis, on which A is fixed, so that a number of men may work at the crane at the same time. If necessary, the power of such a crane as this might be doubled by an additional pulley in a moveable block at P.

The whole machine moves upon the strong upright cast-iron pillar G H, which passes up through an opening at I, where there are friction-rollers, and fits into a cap at H; so that it can easily be made to turn round to any point, and to take up any load within its range.

The crane invented by Mr Bramah, (Fig. 2. Pl. 122.) as we said above, is on the principle of the hydrostatic paradox. In order to understand how it operates, let us suppose A B a strong hollow cylinder of cast-iron, bored quite true, with a diameter say of six inches, and P a piston closely packed, so as to allow no water to pass up by its sides, fitted into it. If into the bottom of this cylinder, which must be equally strong with the sides to resist the great strain, water through a small pipe *a b*, suppose of quarter an inch, be introduced by means of a forcing pump at E, standing in the iron cistern D, on the side of which is the arm intended to support the handle F, and keep it in a vertical position. As the diameters of the two pistons are to each other as 1 to 24, their areas will be as 1 to 576; wherefore the pressure of the water on the one will be to the pressure on the other in the same proportion. If then the handle F of the small pump be pressed down with a force equal to one ton, the piston in the cylinder will be raised with a force equal to 576 tons. And if a pinion K, attached to a drum C, on which the rope R R is coiled, be driven by a rack L, fixed in the top of the piston, it will be impelled with a force equal to a pressure of 576 tons, and raises a load as W, attached to the rope R R, which passes over the pulleys *p p p*. By means of a crane of this description, a large weight can be raised more quickly than it can by any other means through an equal space. The hydrostatic crane has likewise the property of admitting of an increase of power to an almost indefinite extent either by lengthening the lever of the forcing pump, or by contracting the pipe, so as to render the ratio between the area of the two pistons greater. The power, besides, may be conveyed to any distance by means of pipes, and into situations in which effective machines of any other kind could not be placed. It is easy to see how these forces may be applied to the pressing of bodies.

There is a *capstan, or crab,* the invention of George Eckhard, which would make a very powerful barrel for a crane. The principle of it is this: (Fig. 3. Pl. 122.)—Let B C be a compound barrel, the radius of the one part B being 11 inches, and of C 10, and let a rope be coiled round C in any direction, passed over a pulley D of the same diameter, brought back again, and put round B in the

Fig. 2.

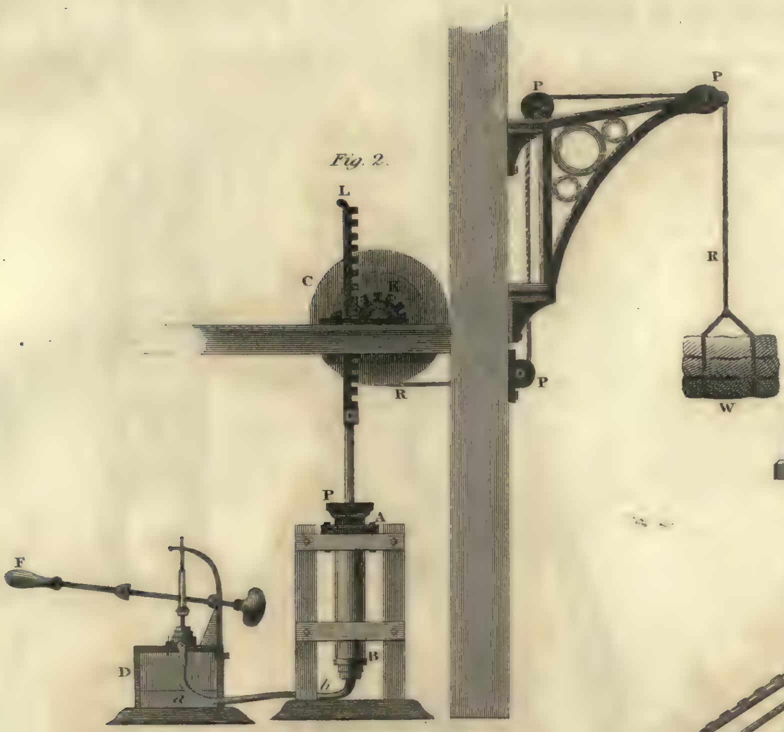


Fig. 3.

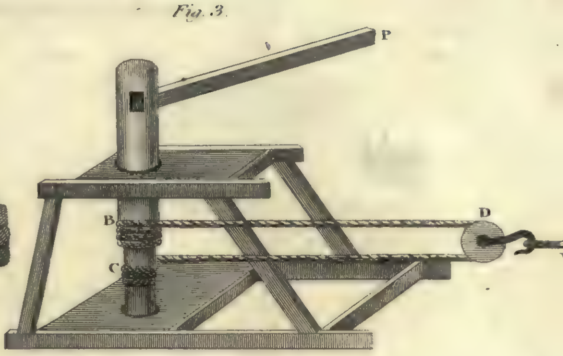
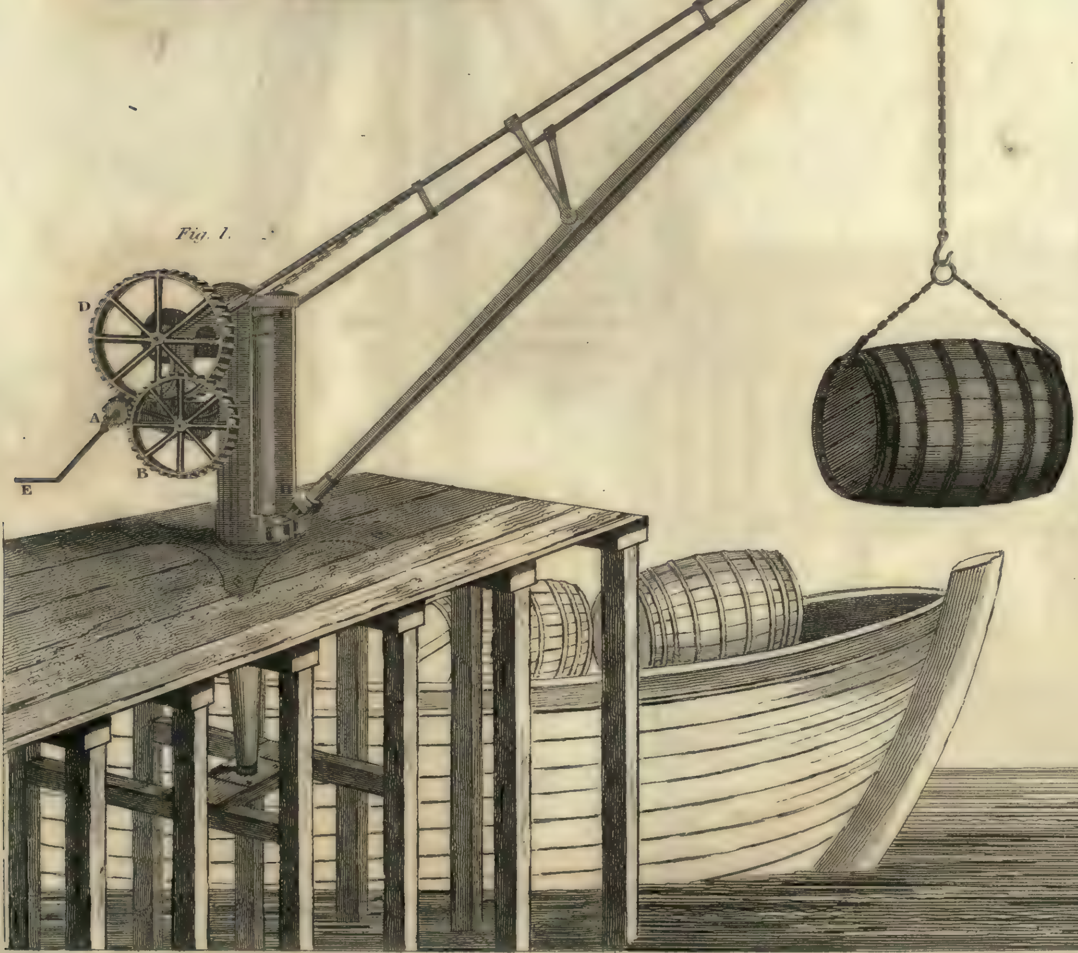


Fig. 1.



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direction opposite to that in which it was coiled about C. It is evident, that every turn of the lever P, which causes the rope to wind round B, will uncoil it from C; and as the circumference of B will be about 63 inches, while that of C will only be 60, 63 inches of rope will be taken up by B, while only 60 are let off from C, and the weight W will be brought nearer the capstan $1\frac{1}{2}$ inch. If a capstan of the common form, with a circumference of 60 inches, had been used, the weight would have been raised 30 inches by one turn of the lever. Consequently, the levers being the same, the power of the common capstan would be to the power of this in the ratio of $1\frac{1}{2}$ to 30, that is, inversely as the velocity of the weights.

In order to increase the power of a capstan of this kind, we have only to increase the thickness of the smaller barrel. Thus, if we would increase the power of such an one as we have described two-fold, we may do it by nailing laths on the surface of the smaller barrel to the thickness of quarter of an inch, and thus the difference between the circumference of the different parts of the cylinder will be diminished one-half. Here we may remark by the way, that we have increased the strength of the machine, whereas if we had wished to make a capstan of the common construction more powerful, we must have weakened it by making the barrel smaller.

It is manifest, that we might separate the axles, and yet, by means of toothed wheels, obtain the same results as when they are united in one, even although they were of the same size. Thus, were a wheel with 63 teeth to drive one with 60, by passing a rope round their axles in opposite ways, we should obtain an instrument of the same power with that which we have just described.

This principle might be applied in various ways in mechanics. Dr Robison, by taking away the pulley from an eight-day clock, and applying a contrivance of this kind, using at the same time iron-wire for cat-gut, converted it into one that went two months.

### *Pile Engine.*

The principle part of a *pile engine* is a heavy weight or ram, moving betwixt two upright beams, by which it is directed upon the head of the stake or pile to be fixed in the ground. This is sometimes raised by means of a pulley by the strength of men, and when at the proper height let down again. In other machines the rope, by which the ram is raised, after passing over a fixed pulley, is wound round a drum attached to a capstan, by the bars of which it is turned. When the ram is at the requisite height, the drum is by some contrivance or other detached from the capstan, which allows the weight to fall, unwinding the rope, and turning the drum in an opposite direction. The drum is again, by some simple operation, fixed to the capstan, and the weight again raised as before.

The following is the description of one wrought by horses, (Fig. 1. Pl. 123.)—I is an upright shaft, which the horses put in motion by means of cross bars to which they are yoked; upon it is placed the large wheel W, which acts on the pinion B, and thus puts in motion the fly L. This fly serves to regulate the motion of the machine, by acting against the horses, and keeps them from falling when the ram is discharged. Over the large wheel is placed the drum N, loose upon the axle, but locked to the wheel W, (as seen in Fig. 4.) and the fusee O. When the horses move forward, the rope R R attached to the follower S, passing over the pulley P, and under the pulley Q, is wound upon the drum, and thus the ram M is raised between the directors A C and A C. As the ram and follower approach the top of the guider A C and A C, the head of the tongs, which are represented in Fig. 3. enter the contracted part T, (seen in Fig. 2.) and are thus opened, and suffer the weight to fall upon the head of the pile. As the horses move on, a hook, which may be seen in Fig. 4. takes hold of the rope T, and thus raises one end of the bolt and depresses the other. By this means the drum is unlocked from the wheel W, and allows the follower and tongs to descend to take hold again of the ram. The motion of the follower in its descent, is prevented from being accelerated by the weight X attached to a rope which passes round the fusee O over the pulleys at V, and is made fast at Z. The follower descending causes the rope to wind about the fusee, and its tendency to an increased velocity is counteracted by the weight acting always at a wider part of the fusee at every turn given it.

The manner in which the drum is unlocked from the wheel may be understood by inspecting Fig. 4. When the end of the bar U is raised by the hook in the follower taking hold of the rope attached to it, the end of it *a f* is depressed; this pushes down the rod *e g* upon the bar *h d*, moveable in a fulcrum at D; the bolt *h c* is thus withdrawn from the hole *c* in the drum, which then turns freely on its axle. There are a number of holes in the drum similar to *c*, but the rapidity of its motion prevents the bar *e* from going into any of them; but when it has stopped, the weight *d* makes it enter the first to which it comes by the revolution of the wheel W. The ram is then raised, and discharged again in the same manner.

The directing beams A C, and A C, are moveable on an axle at the top, and may be placed at any inclination. Thus the pile may be driven either obliquely or perpendicularly at pleasure.

This machine was invented by Valone, and was used for driving piles for Westminster Bridge. The instrument, however, as originally constructed by him, was only fitted to drive the piles perpendicularly, the beams A C and A C being fixed. James Kley, a Dutch mechanician, added the last described part to it, and so fitted it to drive piles likewise obliquely.

### *Water-Mills.*

By the word MILL a machine for grinding corn was originally understood; it is now used to designate any machine in which large wheels are employed. Thus we speak of *water-mills, wind-mills, horse-mills, boring-mills,* &c. Water is made to drive machinery by its *impulse*, by its *weight*, by its *reaction*, and by its *pressure*.

When the impulse of water is made use of to drive machinery, undershot wheels, as they are called, are employed. The wheel is impelled by the water striking against rectangular float-boards. A wheel of this kind is represented at Fig. 4. Pl. 121.

When the fall of water is under four feet, it is recommended to erect an undershot wheel. The best writers on this subject seem to be agreed that the float-boards should be as numerous as possible, not to weaken the rim of the wheel; and that they should not be straight as if continuations of the radii, but rather inclined up the stream about 20 degrees.

Undershot wheels are sometimes made on the principle of the wind-mill. Dr Robison describes a very powerful one of this kind. It consisted of a long cylindrical frame, with a plate about an inch broad, winding round the outside like the spiral of a cork screw. Wheels of this description may be employed with great advantage in deep and slow running rivers.

On the continent, horizontal water-wheels are often to be met with; in this country, however, they have never obtained any footing. Yet from the simplicity of their structure, together with other recommendations, they seem worthy of being pointed out to the attention of the practical mechanic. For a particular account of this, see last edition of *Ferguson's Mechanics*, Vol. V. p. 38.

When the weight of water is employed to drive machinery, the wheel made use of is called an *overshot-wheel*. The water is laid on wheels of this description near the top, and delivered into boxes or buckets, which are placed to receive it, round the circumference, Fig. 1. Pl. 121. Buckets of a shape approaching to that in Fig. 2., No. 1. and 2. Pl. 121. are reckoned best. The maximum effect would indeed be produced, if the whole semi-circumference of the wheel were loaded with water at the same time; and this would be effected, the water being delivered at the top of the wheel, if B C and E F were parts of a circumference, and A B and D E radii of the wheel produced, as at Fig. 4. Pl. 121; but then the openings E C would be too small to allow the water to flow out again sufficiently freely. It would react against the bottom of the next bucket, and would thus retard the motion of the wheel. The water when introduced into the buckets should have a velocity at least equal to that acquired by the wheel, that it may not retard the motion.

An overshot-wheel may with advantage be constructed several feet higher than the fall of water; for in that case the water, when raised by a flood, may, by a particular construction of the sluice, be delivered two or three feet higher than usual, and thus an additional power gained.

A contrivance for delivering the water at different points according to its height in the canal, is shewn at Fig. 1. Pl. 121.—*a* is a pinion turned by a winch and working in the rack *b*, to the lower extremity of which the roller *c*, of the whole breadth of the mill-course, is attached. About this roller there is a piece of leather wrapped, also as broad as the mill-course. It extends to the bottom of the canal, and is firmly fixed to it by two bolts, as seen in the figure. When the water stands no higher in the course than *c e*, the rack is depressed by means of the winch; thus the leather is wound upon the roller *c*, and the water escapes over it through the cast-iron grating, and falls into the buckets of the wheel. When, again, the water is too high, and too much of it escapes, by raising the rack *b* to a proper height, the proper quantity only is allowed to pass, and the power which the additional head gives is thus taken advantage of.

Mr Smeaton found by his experiments that the ratio between the power and effect is in the overshot-wheel as 3 to 2, or as 4 to 5, but in the undershot-wheel only as 3 to 1; so that it would appear that the effect of an overshot-wheel is nearly double of the effect of an undershot-wheel.

An endless chain passing over rag-wheels, with a series of buckets attached to it, forms an excellent and cheap substitute for the over-shot wheel, especially if the fall of water is high and at the same time time scanty.

In *breast-mill* wheels the water is delivered somewhere between the upper and lower part of the wheel, generally, however, below the axis. In this sort of wheel the water acts both by its impulse and by its weight. Here float-boards are used as in the undershot wheel, and not buckets, as in the overshot wheel. After having acted on the float-boards by its impulse, the water is prevented from escaping by the nicety with which the float-boards are fitted to play in the mill-course; and thus the water acts by its weight as well as if it were contained in buckets.

By means of a contrivance similar to that made use of in the sluice of the overshot-wheel, advantage may likewise be taken here of an increase of water by floods.

Breast-mills, it is found by experience, should never be erected when the water is under four feet or above ten feet; for, in the first case, the depth of the float-boards must be so great and their breadth so small, that they cannot properly be employed. The opposite of this takes place when the height gets too great. When the fall is so great as ten feet, overshot wheels ought to be erected; or, according to Lambert, the fall should be divided, and two breast-wheels erected upon it.

*Back-water.*—When the water has acted as an impelling force, it is apt, by accumulating behind the wheel, to retard its motion. One way of getting quit of this inconvenience, is to make the fall by which the water returns to the river sufficiently rapid.

A very ingenious contrivance for the same purpose was hit upon by Mr Burns of Cartside, Renfrewshire, (Fig. 1. Plate 121.) It can be best put in practice in the case of overshot wheels. A current of water is taken from the lead itself, as at A, and by the impetus which it acquires in its descent from A to B, it carries the water, which would otherwise act upon the wheel, forward under the boarding C, behind the perpendicular screen C D, and thus prevents it from returning. The opening under C should be about a third larger than that at B.

As it is of great importance that the fall of water at the wheel should be as great as possible, the slope of the race ought not to exceed an inch in the two hundred yards. In the first 48 yards, however, it will be necessary to make it half an inch, that the water may not flow back into the river.

*Of Corn-mills.*—When water is employed to grind corn, it is generally one or other of these wheels which are made use of. The way in which motion is communicated to the upper mill-stone, by means of which the corn is ground, (the nether one remains at rest,) is as follows: (Fig 4. Pl. 121.) On the axis of the water-wheel, within the mill-house, is a wheel A of pretty large dimensions, with cogs in its rim, by which a lantern or trundle B is put in motion. This lantern is fixed on a strong axis of iron D E, called a spindle. The top of the spindle is square, and has a strong iron cross fixed on it. The upper millstone is laid on the cross, having groves cut in it to correspond to the arms. The spindle turns in a brass bush D, in the strong horizontal beam F G, called a bridge-tree, and in a wooden bush in the nether millstone through which it passes. One end, F, of the bridge-tree is fixed in the wall, the other, G, rests on the middle of a lever called the brayer, one end of which is represented at H as hanging by the bolt O H, which passes through the floor on which the nether millstone rests, and is raised or lowered by a nut at O. In this way the miller is enabled to grind the corn, coarser or finer, as he chooses, by increasing or diminishing the distance between the stones. The upper millstone is inclosed in a box separated from it about an inch all round. In a frame on the top of this the hopper, N M, is placed. Under this, what is called the shoe I K moves, with one end I on a pivot, the other being fixed with a cord K M L, which allows a greater or lesser quantity of corn to fall between the stones, according to the degree of tightness with which it is drawn up by the nut at L. If the shoe be quite drawn up, no corn at all passes down; for the hole in it is not directly under that of the hopper. In a square hole at the top of the spindle, is what is called the feeder or damsel. It has three ribs in the direction of the axle, and strikes the shoe with each of them once for every revolution of the mill-stone. This causes the corn to descend into the eye of the millstone, and fall upon a round piece of leather upon the top of the spindle under the fore-mentioned cross. Thus it is driven between the stones, and becomes meal by their attrition. The centrifugal force which the motion of the stone creates causes the corn to fly farther from the centre at every revolution, and finally to be thrown out through a hole made on purpose in the box which incloses the upper stone.

The nether milstone is in a small degree convex, while the upper is rather more concave. Thus the corn, when it first enters is only bruised, is made smaller as it approaches the edges of the stones, and is quite ground when it is thrown out. In order that the stones may act on the corn more effectually, channels or furrows are cut on them oblique on the one side and perpendicular on the other. In cutting them the following method is observed: The circumference of the stone is divided into a certain number of arcs and radii drawn to each of the divisions. Each of these are cut into furrows. Furrows are likewise drawn perpendicular to them at regular intervals. Both stones are finished in the same way when lying on their backs, so that when in their places the furrows may cross each other, and thus cut the grain by their edges like a pair of scissars. When the furrows are much worn by use, the stones are to be taken up and dressed again; as much weight, however, must be added to the runner as has been taken from it. This will be best done by laying on it an equal weight of plaster. The weight of a millstone, spindle, and lantern, ought never to be less than 1550 lbs. otherwise it will be borne up by the grain, and so be unequal to its work.

In the best mills, millstones of five feet in diameter revolve 90 times in a minute. The number of revolutions which a millstone of any other diameter than 5 feet should make in a minute, is determined by dividing the product of 5 into 90 = 450 by the diameter of the stone to be employed.

In order to cause the millstone to move with the proper velocity, the number of teeth in the spur-wheel, and trundles in the lantern, must be proportioned to the number of turns the water-wheel makes in a minute. Now, an overshot wheel is found to produce the greatest effect when it moves at a velocity of three feet in a second, and an undershot wheel when it moves about one half slower than the water by which it is impelled.

The *velocity of water* may be ascertained either by finding the height from which it falls, and deducting a few inches for the retardation occasioned by friction, &c. or by experiment. When we would calculate the velocity of water from knowing the height of the fall, the following proportion must be made use of. As 16·087 feet, the height through which a body falls in a second, is to the square root of the height of the fall, so is 32·174, the velocity acquired by a body in falling through 16·087 feet, to a fourth number, which will be the velocity of the water. The velocities of falling bodies are as the square roots of the height through which they fall. See Part I. Sect. III. Prop. 1. If we would ascertain the velocity from experiment, which is perhaps the more satisfactory way of proceeding, as good a method as any will be, to take a small wheel of 10 or 12 inches in diameter, and with 14 or 16 float-boards made of very light materials, and moving on a delicate screw for an axis. If then one of the float-boards be marked, and the instrument held to the water, the number of revolutions and parts of a revolution made in a given time, (ascertained by a pendulum or stop-watch,) may easily be found by counting the number of threads of the screw which have been passed over by the wheel, and by measuring the number of degrees additional that have been described by this marked float-board. The mean circumference of the wheel multiplied by the number of revolutions, will give the number of feet moved over by the water in the given time, some allowance being made for the friction of the screw, resistance of the air, &c. The same may be effected by indices and scales, fitted to this wheel, in order to mark the revolution and parts of a revolution. This was the method employed by Bossut. If the circumference of the wheel be then divided by the velocity of the float-boards per second, the quotient will give the number of seconds in which the wheel revolves. Divide the last number by 60, and the quotient will give the number of revolutions made by the wheel in a second.

Divide 90 (the number of revolutions which a millstone five feet in diameter ought to make in a minute) by the number of revolutions made by the wheel in a minute, and the result will give the number of revolutions the millstone ought to make for one of the wheel: Then as the number of revolutions of the wheel is to the number of revolutions of the millstone, so must the number of staves in the trundle be to the number of cogs in the wheel, in the nearest whole numbers that can be found.

These rules are the same as those given by Mr Ferguson, and adapted by Dr Brewster to what is reckoned the best velocity of a millstone. According to Mr Ferguson, a millstone six feet in diameter ought to revolve only 60 times in a minute.

*Hunting cog.*—The impossibility of making every thing mathematically true in large machines renders it advisable to make the number of teeth in the spur-wheel and spindles in the lantern prime to each other; that is, so that the one may not divide the other without a remainder: in this way periodical irregularities will be prevented from taking place. Thus, if, in order to make a stone turn 90 times in a minute, it were necessary to give the spur-wheel 60 cogs, and the trundle 10 staves, it would be better to give the spur-wheel 61 cogs. This would only have the effect of causing the millstone to move a little faster than 90 times in the given period, and would have the advantage of making every thing wear equally. The name given to this supernumerary cog is that of a *hunting cog.*

*Form of cogs.*—The form which the acting faces of the cogs in the spur-wheel ought to have, according to what we have said in Sect. I. of this Part, is that of an exterior epicycloid, generated by the rolling of the primitive of the lantern on the primitive of the wheel.

The following, however, is a sufficiently near and very simple approximation to the proper form. With a line, A B, Fig. 3. Plate 121. equal to the radius of the lantern, describe the segment B F, and with the same radius describe C D equal to it; join the points D and F by a straight line D F, which bisect in E by the perpendicular G E: make the whole revolve round this as an axis, and the figure produced will be that required for the cogs.

Machines, as we have said above, are likewise driven by the reaction of water; of this description is that commonly called *Barker's mill.* To understand the principle of this machine, let us imagine B C F G, Fig. 5. Plate 121. a vertical pipe, connected with two horizontal arms A B and G H, and capable of revolving together with its axis D E. If we suppose the whole filled with water, there will be an equilibrium, for the pressure on every part is counteracted by one equal and opposite. But if a hole be opened in one of the horizontal arms, as at A, the equilibrium will be destroyed, and the whole machine will have a tendency to turn round in a direction opposite to the part in which the hole is, with a force equal to the weight of a column of water having for its altitude the height at which it stands in C B, and for its base the aperture at A. If the supply of water be sufficient, a hole may be made in the arm G H, also on the side opposite to that in the other arm. The force will then be equal to the weight of two columns of water of the height at which it stands in B F, and with their bases equal to the apertures at A and H. This machines acquires an additional power after it is put in motion; for the centrifugal force impressed on the water makes it press more strongly toward the ends of the arms A B and G H. This way of employing water is reckoned to be at least as effectual as an overshot wheel would be with an equal fall of water.

It does not appear that this very advantageous way of employing water as a moving power has ever been adopted for any other purpose than merely for corn-mills, and this only very partially. When this power is used to impel corn-mills, the upper stone is placed on the top of the axis D E: it is manifest, however, that by substituting a wheel for the stone, it may, with great facility, be applied to drive any other kind of machinery.

According to the common method of constructing this machine, the spindle D E must necessarily be higher than the fall of water. It has, therefore, been suggested by M. Mather de la Cour, to introduce the water into A H by a bent pipe from below, and thus the spindle need not be made longer than other circumstances may require.

Till very lately, except in the case of Mr Bramah's cranes, presses, &c. no advantage of the powerful principle of the hydrostatic paradox had been taken in machinery. Within this year or two, however, Mr James Dickson, civil engineer, has applied it as an impelling power to machines of every kind. By means of it he has been enabled to make a small quantity of water, with a great fall, do the work of a great quantity with a small fall. This invention has, besides, this advantage, that the fall is equally efficacious above and below the impelled point.

Mr Dickson's engine is represented at Figs. 6. and 7. Plate 124., the same parts being marked by the same letters. A is the pipe by which the water is conveyed from some height to the engine; 1, 2, and 3 are stop-cocks; and the pipe M, a continuation of A, that by which the water is conveyed from the engine; C is a cylinder, with a piston working in it: by the rising and falling of this, a crank is turned, and the wheel W, which connects the engine with any other machine, is put in motion. E and G, F and H, are four valves; E and G are always shut when F and H are open, and *vice versa.* Each pair of valves are connected, and alternately opened by the rod on the eccentric wheel V, and that by the weight T.

Let us suppose now the piston at the bottom of the cylinder, the valves E and G open, while F and H are shut; if the stop-cock 1. be opened, and the stop-cock 2. shut, the water will be forced to rise in the vertical pipe B, will pass through the valve E, enter the cylinder *c* under the piston, and push it before it to the top of the cylinder. This will cause the valves F and H to open, but E and G to close. The water will therefore rise to F, pass through it into the cylinder above the piston, and will press it down; for what water was injected through E will, in the meantime, have escaped through H down the vertical pipe, and along M, to the place of discharge. During the descent of the piston, the valves F and H will be shut, while E and G will be opened; and this operation will continue to be repeated while the supply of water lasts. The column of water in the lower pipe M adds to the height in the upper pipe A by relieving the eductive orifices at G and H alternately of the weight of the atmosphere, by a quantity proportional to the depth of the point of discharge below them. If the perpendicular depth of the point where M discharges the water be 34 feet below G and H, and the end of the pipe be immersed in water to prevent the entrance of air, when the eductive valves are open the water will issue into a vacuum, and thus the force of the upper column of water in A will be increased by a quantity equal to the weight of the atmosphere.

What we have now described is the principal part of the machine. The way in which the water is applied must strike every one as similar to the manner in which the steam is made to act in Watt's engines; and the invention displays no small degree of ingenuity.

There are, besides, some very good subsidiary contrivances in this engine. These we shall describe in nearly the inventor's own words.

"In order that no water may pass along without entering the cylinder, one set of valves is made to shut before the other opens; but as water is nearly incompressible, every time it is stopped, or its course suddenly altered, when confined, as in this machine, it would give a shock to its several parts, and tend to loosen its joints. To counteract these effects in the upper column, the air-vessel O is placed on the pipe that leads to the cylinder, as near it as is convenient, and when any set of valves is shut the water in A rushes into O, and condenses the air in it more than the water of the column A at rest would do. Hence, when the next set opens, the water is pressed out, and a current is also continuing to descend along A."

"The air-vessel P, which is joined to the pipe leading from the cylinder, gives to that pipe a more equal current than it would have without it; for, when one set of valves is shut, the column in M would be suspended till the other set opens, which would give a concussion to the whole machine. Before the machine, therefore, is put in motion, the stop-cock 3. is shut, and 1. and 2. opened, and the water running into P expels the air through a small cock, the end of which goes down into the top of the vessel about an inch. Let us now suppose one set of valves shut, then a current will begin to flow out of P, and the air that was not allowed to get out of the top of the vessel will be dilated; consequently, when the other set of valves opens, the air being expanded beyond what the column M at rest would keep it at, water will be drawn in by P, to be given out the next time the valves shut."

If air were allowed to remain in the cylinder, either in the bottom of the piston or between the piston and cover, it would cause a halt or pause as the crank turned the centre at top and bottom, for the air would be alternately condensed and dilated by the pressure of the upper and suction of the under column. Hence, a space of time would elapse before their combined effects were felt by the piston, and there would also be wasted, every half-stroke, the quantity of water that A supplied to compress the air, and run off by M to dilate it. In order, therefore, that the air may not only be taken out at first, but that the machine may continue to discharge any that may be disengaged by the water coming in contact with the metal, or other causes, the under side of the piston is turned, to cause all the air below it to be collected at one point, and a small hole made there, by which the air is transferred to the upper side of it, and the cover being turned in the same manner all the air is collected at one point in the cover; and through the under side of the flanch of the cylinder is introduced a pipe, the end of which goes into this hollow in the cover where the air is collected, and in the descent of the cylinder the water pressing it down also presses out the air by this tube, the other end of which is also fixed into the pipe M. If an air-pump is to be used, it may be applied at Z, or at any plane along the pipe M."

"As the piston," he adds, "is always either ascending or descending, however small be the space of time between the shutting of one set and the opening of the other set of valves, the piston will have moved. In order, therefore, to allow the piston to travel during the time that all the valves are shut, and no water either coming in or going out of the cylinder, there is a small cylinder, D, at the back of the large one, having a communication with it at top and bottom. Into this cylinder there is fitted a piston with a screwed rod, which can be lengthened or shortened, so that this piston, with its rod, which is completely enclosed, may have a range just sufficient to contain the water that remains to be displaced from the upper side of the large piston when at the top, and the under side of it when at the bottom."—See *Edinburgh Philosophical Journal*, Vol. III. p. 176.

*Hydrometer.*—Although the hydrostatic balance is the instrument generally made use of to ascertain the specific gravity of all bodies when great accuracy is required,—if expedition is necessary, and an approximation only is wanted, the specific gravities of fluids are usually found by means of an instrument called an hydrometer or water-poise.

This instrument generally consists of two hollow balls of copper or glass, a larger one with a smaller below it, into which leaden shot or mercury is introduced, in order to make the instrument float steadily when immersed in the fluid. On the upper part of the larger ball, a stem or stalk is fixed, on which there is a scale or index to mark the depth to which the hydrometer sinks in the fluid. The instrument will evidently sink deeper in a light than in a heavy or dense fluid; for if the liquid is light, more of it must be displaced, in order that it may be of equal weight with an immersed body, than if it were heavy. Some hydrometers, such as Jones's, Guyton's, &c. are made very delicate, and shew the corrections necessary to be made for difference of temperature.

Dr Wilson of Glasgow proposed a way of ascertaining the specific gravities of fluids a little different from this, though the same in principle. His method was to take a number of glass beads of different specific gravities, and put them into the liquor under examination. Those beads lighter than the fluid, remained at the surface, the heavier sunk to the bottom, while those of the same specific gravity floated in the middle without either rising or falling.

These beads have been greatly improved by Mrs Lovi; and they are to be had under the name of *Lovi's patent areometrical beads*, neatly fitted up in cases, and accompanied with a thermometer and sliding-rule, for making the necessary corrections for the difference of temperature, &c. This kind of hydrometer has the advantage that, if one, or even more, of the series of the beads be lost or damaged, its usefulness is not much impaired, for the specific gravity may still be ascertained with considerable accuracy without them; whereas, if an hydrometer of any other kind should meet with any accident, it can hardly again be repaired.

### *Machines for raising Water.*

*Persian wheel, &c.*—Water is often raised by means of a stream turning a wheel on which are hung buckets moving freely backwards and forwards on pins by which they are suspended. When at the lowest part of the wheel, the buckets are immersed into the stream, and thus filled. When these come to the top of the wheel, the under parts of them are made to strike against a box or trough, which causes them to discharge their contents into it. They then go down empty, and come up again in their turn with a fresh supply.

In a large wheel of this kind at Blair-Drummond near Stirling, the lifting buckets are formed like the buckets on an overshot wheel, only they are placed on the inside of the wheel, and thus empty themselves of their own accord, without any additional contrivance, as they approach the top of the wheel, into the trough placed to receive their contents.

Water is sometimes raised by a wheel, of which the spokes are curved and hollow within. This contrivance, however, carries the water no higher than the axle of the wheel.

*Archimedes's screw.*—The screw of Archimedes for raising water, may be formed in various ways; by winding two flexible pipes, as of leather, lead, &c. round a cylindrical axis at a given angle; by cutting in this axis a double screw, like what we see on the fly of a common jack, and covering it over with boards like a cask; or by making plates of metal to wind round an axis, and covering them over, &c.

A screw constructed in any of these ways, and inclined to the horizon at an angle which is greater than that which the spiral has to its axis, will, if turned from left to right if the spiral proceeds from right to left, or from right to left if it proceeds in an opposite direction, when its lower end is immersed in water, cause the water to rise and flow out at its top. The way in which this effect is produced will be clearly understood by taking a common cork-screw and hanging a weight to it by a double thread. If the screw be inclined to the horizon at a greater angle than what the spiral of the screw makes with the axis, and made to revolve on its axis contrary to the direction of the spiral, the weight with the thread will ascend to the top of the screw as it turns; for as the part of the screw on which it hangs is raised, the thread will descend toward the lower part of the spiral, which will always be toward the top of the screw.

In practice, the inclination of this machine should be about 50°, and the angle which the spirals form with the axis should exceed the inclination of the machine about 15°. This instrument may be applied to raise sand, gravel, meal, or any material of which the grains are sufficiently small.

*Whitehurst's machine.*—The machine represented in the figure is one for raising water by its own momentum. The inventor of it was Mr Whitehurst, an ingenious watchmaker of Derby. Fig. 4. Pl. 124. A is the spring of water, the surface of which is of the same level as the bottom of the reservoir B. The main C is about 200 yards in length, and about 1½ inches in diameter. The pipe E G, intended for the supply of a washing-house and offices, at least 18 or 20 feet below the original spring, of the same diameter. The cock G is about 16 feet below C, the bottom of the spring. There is a valve and valve-box at D, and an air-box at F, in which the ends of the pipes C D and F I are inserted, and bent down at the extremities, in order to prevent the air from being driven out of the box when the water is forced into it. If the cock G is opened, the water will issue with a velocity due to a height of 16 feet, or at the rate of 32 feet per second nearly. And as the main is about 200 feet in length, and 1½ inches in diameter, the column must have a very considerable momentum. If, therefore, the cock be suddenly shut, the water will rush through the valve at D into the air-box F, and the air in it will be condensed. This will happen every time the cock G is opened and shut again; wherefore the condensed air in F will press on the water in it, and cause it to rise into the reservoir at B.

The *Hydraulic ram*, invented by *Montgolfier* about the year 1797, is an instrument constructed on the same principle as Whitehurst's machine, only by using valves instead of a cock it is made to work without superintendance. This curious and interesting machine is represented in Fig. 1. Pl. 124. P Q is the reservoir of water, A B the main of the ram, having a funnel-shaped mouth at A, in order, according to the maxim of Prof. Michelotti, mentioned above, that the supply may not be diminished by the *vena contracta*. C and D are two valves, through which, when open, the water will issue with a velocity which, abstracting from friction, &c. is the same as what a body would acquire in falling through a height equal to that of P above the point at which it is discharged; but when the valve C is shut, as in the figure, the water is prevented from escaping. The valve C opens by descending into the position marked G G (Fig. 2.) guided by four straight stems, *g g*, having hooks below; the water has a free passage through these stems, but by bringing them closer together, which may be done by means of the screws by which they are fixed, the opening for the water may be contracted. There is a hollow metal cup soldered under C. The valve D is exactly the same as C, only when it opens it ascends, and closes the passage for the water when it descends. The part

*Fig. 1.*

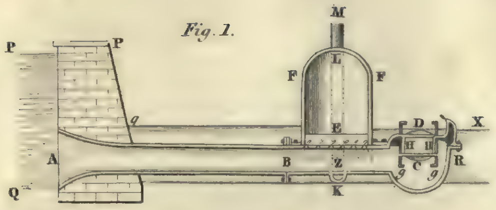


*Fig. 4.*

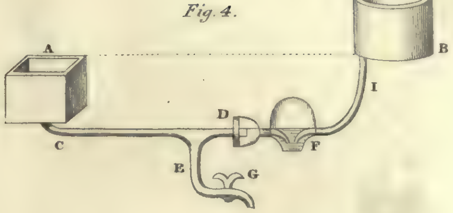


*Fig. 2.*

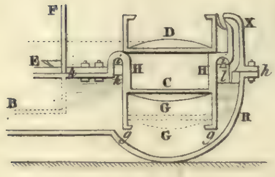


*Fig. 3.*

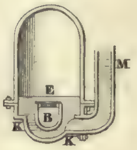


*Fig. 5.*

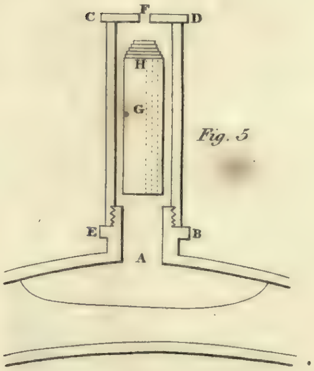


*Fig. 6.*

*Profile*

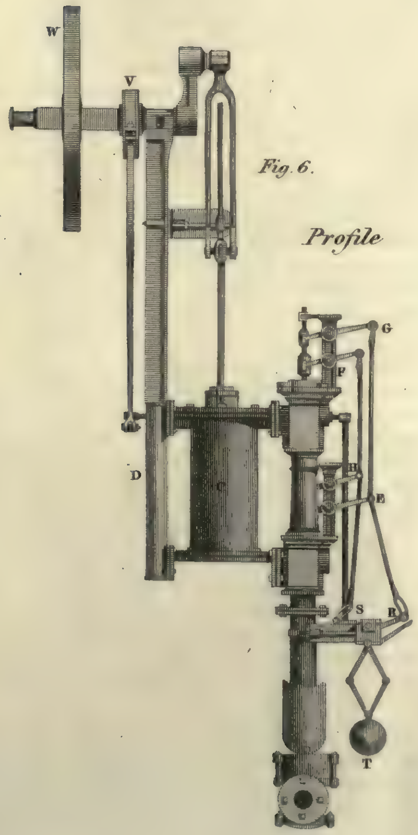
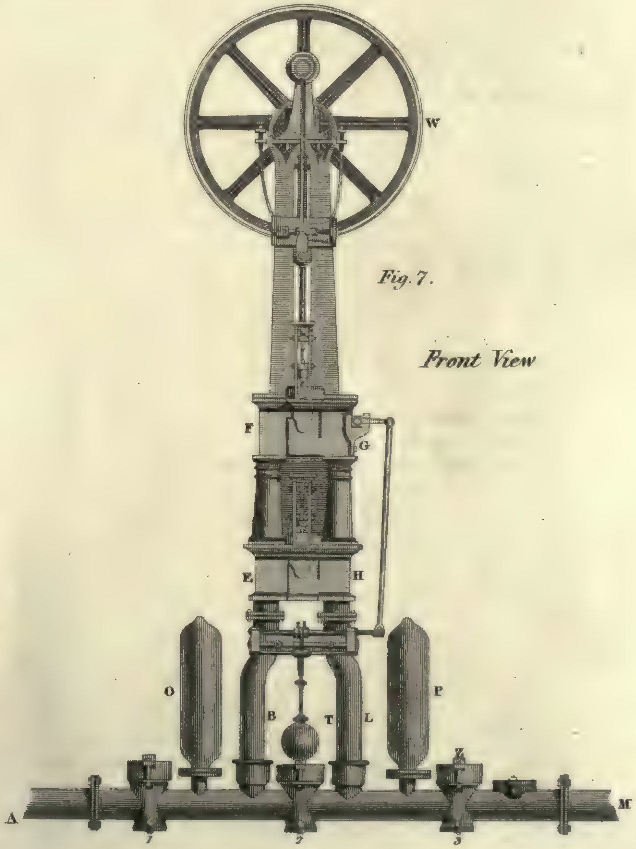


*Fig. 7.*

*Front View*



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H H, which is the seat of the valves, is wider than the body of the ram A B. It is a short cylindrical pipe, and is screwed to the head of the ram R, its flanch *h h*. Round the top of this short pipe is a small annular cavity, *i i*, for containing air, which cannot escape when compressed by the water in the ram. This cavity is supplied with air by means of a small pipe, *l k*, furnished with valves, *l* and *k*; but *l* shuts after admitting a small quantity of air into the pipe *k l*, while *k* opens inwards and admits the air into *i i*, but by shutting again prevents it from escaping. On the upper side of the pipe A B, at E, which is made flat, (as seen at E, Fig. 1.) there are a number of valves, which allow the water to pass into the air vessel F F, but by their closing prevent its return. The body of the ram passes through this air vessel. This part of the construction is seen more clearly in Fig. 3.; it is marked by the dotted lines *k* in No. 1.

Let us now suppose the pipe A B R full of water, the valve C open, or in the position marked G G in Fig. 2, the water will flow into H H with a velocity due to the height at which it stands in the reservoir, raise D, and make its escape. But having in a little time acquired a greater momentum, it will raise the valve G G, and shut the passage of the water. This will cause an hydrostatic pressure. The shock which it would give the machine will, however, be somewhat broken by the compression of the air in *i i*, which here acts the part of the air vessel O in Mr Dickson's machine, (Fig. 7.) and by the yielding of the metal of the pipe. This pressure will open the valves at E, and water will escape into the air vessel F F, and condense the air in it, but will be prevented from returning by the closing of the valves. The elasticity of the compressed air in *i i*, and the reaction of the metal of the pipe will now cause the water in A B R to return with a slight motion from B to A. In consequence of this, the valve *c* being unsupported will fall down to G G, and air will be taken into *i i* through the pipe *l k*; the quantity will however be very small, as the valve *l* will close whenever the motion of the air becomes rapid. The motion in the pipe from B to A being now spent by the reaction of the water in the reservoir, the water will begin to flow again from A to B; and the same operation which we have described will continue to be repeated without end, water being taken in through the valves at E each time. Thus the air in the vessel F F will be highly condensed, and the water will spout through M M, 1. and 3. with a velocity proportional to the elasticity of the air in the vessel F F. A constant supply of air is afforded to F F from the cavity *i i*; for, on the retrograde motion of the water, a small quantity passes along the pipe to the space below the valves at E, and is driven into F F on the next stroke of the machine. A machine of this kind with a fall of five feet, a main of six inches in diameter, and 14 feet in length, will require about 70 cubic feet of water in the minute to work it, and will raise in that time $2\frac{1}{2}$ cubic feet to the height of 100 feet.

The ingenious inventor of the machine has applied it to make foul water raise clean water even from a deep well; to produce a current of air, &c. See *Brewster's App. to Ferguson's Mechanics*; *Repertory of Arts*, December 1816; *Journal of the Royal Institution*, Vol. I. p. 216. Lond. 1816.

*Rules for the strength of pipes.*—We shall conclude this section with some observations on pipes for conveying water. The following very useful rule has been given for constructing pipes, intended to convey water, of sufficient strength. The thickness of the edge ought to be equal to the product of the diameter of the pipe into the perpendicular height of the water in it, divided by the relative strength of the materials of which it is constructed. That is, calling the diameter $d$, the perpendicular height of the water $a$, and the relative strength of the materials S, the thickness of the pipe ought to be equal to $\frac{ad}{S}$.

Hence, if we know what strength a pipe of any dimensions, and of any metal, ought to have, we may, by a single proposition, discover what thickness ought to be given to a pipe of any other materials, and of any other dimensions. Thus, it having been found that a leaden pipe 16 inches in diameter, filled with water to the height of 50 feet or 600 inches, should be $6\frac{1}{3}$ lines in diameter, (this follows from an experiment of Roemer,)—if it were required to know what ought to be the thickness of an iron pipe 5 inches in diameter, the water in which was to be of the altitude of 30 feet, we should have the following proportions, the strength of iron being to that of lead in the ratio

$$79 : 1 ; \frac{600 \times 16}{1} : 6\tfrac{1}{3} : : \frac{360 \times 5}{79} : \frac{3}{700} \text{ of a line.}$$

According to Bossut, when conduit pipes are made of lead, the diameters being

1, $1\frac{1}{2}$, 2, 3, $4\frac{1}{2}$, 6, 7, inches,

the thickness should be $2\frac{1}{2}$, 3, 4, 5, 6, 7, 8, lines.

When of iron the diameter being

1, 2, 4, 6, 8, 10, 12 inches.

the thickness should be 1, 3, 4, 5, 6, 7, 8 lines.

In order to prevent the supply of water being cut off by the bursting of the pipes in frost from the expansion of the water, Mr Wright of Kennington recommends the application of an air valve, in order to keep them empty when not required. See *Phil. Mag.* for July 1814, p. 147.

As the accumulation of air in pipes, from various causes, by being taken in at the source, or forced in along with the water when a forcing machine is used, or being disengaged from the water itself in the pipe, would soon cause a great diminution in the supply, or perhaps stop it altogether, it is absolutely necessary that it be extracted in some way or other. This may be done by placing cocks at the upper bendings where the air must accumulate, and giving them in charge to some one to open occasionally; or one end of the key of the cock may be made to float in a small cistern, by means of a hollow ball of copper fixed on it. When there is air in the pipe, the water in the cistern decreasing will allow the ball to fall down and the cock to open, and consequently the air to escape; water will follow, raise the ball, and close the pipe again. This, however, implies a loss of water. The same purpose may be effected by a very neat contrivance, mentioned by Dr Robison as an invention of Professor Russel, without any leakage. It consists of a cylindrical pipe A F, (Fig. 5. Plate 124.) screwed on the upper side of a bend in the main, with a small perforation, F, in the top, which is a flat plate. Within the pipe a hollow copper cylinder, G H, plays, on the upper end, H, of which is a soft piece of leather.—When there is air in the main, it escapes by a hole into the cylindrical pipe, and passes through the perforation F in the flat plate; the water following raises the hollow copper cylinder to the top of the discharger, and, pressing the leather against the hole F, shuts it, so that none escapes.

The upper opening of a pipe ought always, if possible, to be two feet under the surface of the water, in which case no air will enter with the water. There should also be lids, with floats attached to them, to shut the pipes when the water gets too low.

*Method of removing gravel, &c.*—In order to remove sand, gravel, &c. which, in spite of the most careful filtration, will gather in the pipes, cleansing plugs should be placed a little beyond the lever bends on the under side of the pipes, so that when opened the velocity of the water may carry the deposition along with it.

Care should be taken that no unnecessary obstructions be occasioned to the motion of the water, by pieces of solder being left hanging in the pipes. It is manifest, that any contraction in a pipe must diminish the supply of water; but enlargements ought also to be avoided: because, when water is moving along the pipe, the velocity must be inversely proportional to the area of the section. The velocity will therefore be diminished at the enlargement, and must be again increased at the contraction, which must necessarily consume part of the impelling power.

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MECHANIC, or MECHANICAL, denotes something connected with mechanics; and mechanical affections are such properties of matter as relate to bulk, motion, and figure. It also is a term applied to a common tradesman, as a carpenter, mason, or smith.

MECHANISM denotes either a machine or its constituent parts; as the mechanism of a watch or clock, &c.

MECKLENBURG, a duchy of Germany in the circle of Lower Saxony, bounded on the north by the Baltic, on the east by Pomerania, on the south by Brandenburg, and on the west by Holstein and Luneburg; is 135 miles in length, and 80 in breadth, and presents a finely diversified aspect. The soil and climate are favourable, and, besides excellent pastures, rye and wheat are abundant. The Elde, the Stor, and the Reckenitz are the principal rivers, and the chief towns are Mecklenburg, Rostock, Schwerin, and Weimar. The manufactures are chiefly woollen stuffs, leather, and tobacco. The exports consist of corn, hops, flax, hemp, cattle, cheese, and timber; in return for which salt, sugar, and tobacco are imported. One of the two lines of the House of Mecklenburg commenced in Duke Adolphus Frederick II. whose second sister was consort to George III. Mecklenburg is governed by means of the privy council of regency, the demesne chamber, and the high and provincial court of justice.

MEDALS. See NUMISMATOGRAPHY.

MEDIA, was the seat of an ancient empire of Asia, bounded on the north by the Caspian sea, on the south by Persia and Assyria, on the east by Parthia and Hyrcania, and on the west by Armenia Major. The name was probably derived from Madai, the third son of Japhet. Having been under subjection to the Assyrians before the reign of Sennacherib, the Medes afterwards lived in a state of anarchy until about 699 B. C. when one Dejoces became king, and effected, in some degree, their civilization. In the reign of Cyaxares I. commenced the united empire of the Medes and Babylonians; and, during the reign of Cyaxares II. who succeeded his father Astyages in 560, the Babylonish empire was annihilated by the Medes. Under Cyrus, the next successor, the seat of empire was transferred to Persia. See PERSIA.

MEDIATOR, one who intercedes or acts between two parties; but the term applies in a peculiar sense to Jesus Christ, the only intercessor between God and man. (1 Tim. ii. 5.)

MEDICAGO, Snail Trefoil, a genus of plants belonging to the Diadelphia class.

# MEDICINE.

Introduction

MEDICINE is a very extensive and important department of human knowledge, comprehending not only what is strictly termed the *Healing Art* in its various branches of PHYSIC, SURGERY, and MIDWIFERY, but every thing relating to the preservation of health, the prolongation of life, and the cure or alleviation of disease.

It is divided into *Theoretical* and *Practical* medicine. The former comprises the principles of the art, including PHYSIOLOGY, or a knowledge of the animal economy in a state of health ;—PATHOLOGY, or the general knowledge of the animal economy in a state of disease ;—DIETETICS, or a knowledge of the means employed to sustain life ; and MATERIA MEDICA, or a knowledge of the remedies used to remove or alleviate disease. The latter comprises the practice of the art, including HYGEIOLOGY, or the rules to be observed for preserving health ;—THERAPEUTICS, or the general application of remedies to the cure of disease ;—PHARMACY, or the art of preparing those remedies, or reducing them to the most convenient and efficacious forms for administration ;—SURGERY, or the art of curing or alleviating external diseases, or internal by external means ; MIDWIFERY, or the art of relieving females in childbirth, and administering to the diseases which more particularly attend or follow that situation,—and the practice of PHYSIC, or the art of curing internal diseases, or external, chiefly by internal means.

In giving these definitions of the departments of practical medicine, respect is paid rather to their general acceptation than to their true and legitimate meaning; for it is certain that the line of demarcation, between the practice of the physician and that of the surgeon or practitioner of midwifery, is often very indistinctly traced, and experience shews that, however custom and etiquette may attempt to draw the distinction, those practitioners must often, for the benefit of their patients, encroach on the province of each other.

Of the departments just mentioned as belonging to medicine, some have been anticipated in this work. PHYSIOLOGY has been treated of under ANATOMY. DIETETICS occupies a place by itself under that title. THERAPEUTICS and PHARMACY are included under MATERIA MEDICA. MIDWIFERY and SURGERY will also be considered under those titles in the sequel. The remaining departments will form the subject of the present treatise so far as they relate to human medicine. *Veterinary* medicine, or the management of domestic animals, with a view to the preservation of their health, and treatment of their diseases, will immediately follow in a separate treatise.

Though the practice of physic, so far as it relates to internal diseases, has been called a conjectural art, the utility of medicine in general has never seriously been called in question, even by the fatalists. However speculatists may reason on the powers of nature, and their sufficiency in curing disease and relieving the system from morbid parts and principles, they willingly fly for aid to the surgeon or physician, when attacked by any painful or dangerous malady. The successful reduction of luxations and fractures ;—the perfect union of separated parts ;—the stopping of a hemorrhage, that would otherwise prove fatal, by the application of ligatures and compresses ;—the preservation of life by the amputation of a diseased limb or organ ;—the restoration of sight by the extraction or dispersion of the *lens* in cataract,—are justly boasted of by the surgeon, as among the most splendid atchievements of his art ; but they are not more beneficial to mankind than many of the cures effected by the physician. The almost certain cure of intermittent fever by Peruvian bark and arsenic,—the effect of purgatives in arresting continued fever, tetanus, and some other spasmodic diseases ;—the benefits arising from the proper administration of opium in cholera and many painful affections, and of mercury in liver complaints, dysentery, and dropsy ;—the prevention of death from poisons, by emetics followed by the proper antidotes ; and the expulsion of the tape-worm by oil of turpentine,—are only a few of the advantages arising from internal medicines. Mankind are indebted to medicine for the success with which contagion is now checked in civilized countries, and for the extinction of the small pox, or disarming it of its virulence.

The *relations* that subsist between medicine and some other departments of human knowledge are best illustrated by a few remarks on the qualifications which should be possessed by him who proposes to make the practice of medicine his profession. These qualifications are either original or acquired. An intended practitioner of medicine, in any of its departments, should possess a *good constitution*, as his practice is often laborious, especially in the country. His sight should be good, and his *hand* steady, more especially if he is to practise surgery. He should possess *good temper* and *suavity of manners*, that he may soothe as well as relieve his patient. He should be possessed of a moderate *independency*, especially at the present time, when the number of practitioners is so enormously increased that it is impossible for many of them to gain even a livelihood by their profession.

With respect to his acquirements, the medical student should have received a liberal education previous to his entering on the study of medicine. He should be so far master of the *Latin* language as to be able to read it with ease, and write it with fluency and correctness, or at least with perspicuity, as many excellent works, especially on the continent, and all medical prescriptions, are still written in that language ; and, if he is to be candidate for a diploma, he *ought* not only to write his own Thesis, and the other usual exercises, but to be able to defend them when required. *Greek* is no longer considered a *necessary* part of a medical education, as the principal works written in that language have been translated, but it must be regarded as a valuable accomplishment. Next to Latin, French is the most useful language; and, where time and opportunity allow, it is proper to study *German.* The elements of *Mathematics*, especially Arithmetic, Algebra, and Geometry, are necessary, as an Introduction to *Natural Philosophy*, several departments of which, as Mechanics, Pneumatics, Optics, and Electricity, serve to illustrate the laws of muscular motion, the mechanism of respiration, the nature and laws of vision, and the effects of a powerful agent on the system. *Logic* and *Metaphysics* must form a part of his studies, as they will teach him the philosophy of mind. *Natural History*, in all its departments of Zoology, Phytology, and Mineralogy, is essential, as it makes him acquainted with the substances which he is to employ, and with the nature and properties of those animals, vegetables, and minerals which, as parasites or poisons, become causes of disease. An extensive knowledge of Anatomy is indispensable to the medical student, especially if he is to practise surgery, in which case he must not only be accurately acquainted with the human structure from observation, but must render himself familiar with it by actual dissection. A competent knowledge of *Comparative Anatomy* is also very useful. *Chemistry* is another collateral branch of the greatest importance in a medical education, as it assists anatomy in investigating the intimate structure of the body, and the nature of its component principles; aids Physiology in explaining some of the principal functions, especially digestion and respiration, and forms a necessary introduction to Pharmacy. Anatomy, Chemistry, and Botany are always taught in the medical schools, and the two former are the first that should engage the attention of a medical student.

## PART I. HYGEIOLOGY.

By this term, which is here substituted for *Hygiéne*, we understand the art of preserving health, or what has been called *prophylectic* or *preventive* medicine. It teaches the means to be employed, and the circumstances to be avoided, for maintaining the bodily and mental functions in a healthy condition.

Life has been termed a *forced state*, and not improperly, as the preservation of it depends on the constant attention of its possessor, and the repeated and continual employment of certain *stimuli*. Although perfect health be not essential to the *continuance* of life, life cannot be perfectly *enjoyed* without it. The means of preserving health have been usually classed under seven heads: diet, apparel, air, exercise, sleep, the regulation of the excretions, and the regulation of the passions. But it is more consistent with the general plan of this treatise, and especially with the order in which the symptoms of diseases are to be arranged in the Part treating of Pathology, to class them according to the *functions*, as explained under ANATOMY, as they relate to Motion, Sensation, Digestion, Respiration, Secretion, and Excretion, and the functions of the skin. The first will include exercise and rest; the second sleep, watchfulness, and the regulation of the passions; the third, diet; the fourth, air; the fifth, the regulation of the excretions; and the sixth, apparel and cleanliness. These will be briefly discussed in the order in which they are enumerated.

*Motion.*—It is well known, that indolence and sedentary occupations are prejudicial to health. A certain degree of voluntary motion is necessary to the healthy action both of the body and the mind; but the degree and the kind of exertion must be regulated by the circumstances in which the individual is placed. The infant, in ordinary health, is dandled in the nurse's arms, till it can sprawl, creep, or run by itself. A healthy child is, while awake, in perpetual motion; and nothing is more injudicious than to compel such a one, under five years of age, to sit for hours together at the book, the needle, or the piano. As children advance in age towards puberty, their exercise may be gradually abridged, but they should still be allowed some hours in the day for bodily exertion. Walking, dancing, running, leaping, swimming, the active games of fives, golf, and cricket, and moderate labour in the field or garden, are proper exercises for growing children; but they should not, if it can be avoided, be subjected to severe or long continued labour. Youth and manhood are the seasons for labour. Then the peasant may toil with impunity, and the gentleman with advantage, from morning till sunset, in the field, the garden, or the forest, and each will enjoy his evening meal the more for having earned it by the sweat of his brow. As man declines in years, he requires and bears less exercise. Even walking long produces fatigue; and he is commonly obliged to have recourse to what is called *gestation*, riding on horseback, or in a carriage.

Females, after the age of puberty, usually require less bodily exertion, or bear the want of it better than males; but the degree must be regulated by situation and habit.

The *constitution* of the individual must also be regarded in determining the kind and quantity of motion he requires. What would be only gentle exercise to a robust person, may prove fatiguing labour to one more delicate. The valetudinarian must usually content himself with a ride, an airing, a sail, a short walk in a well ventilated room, a moderate use of dumb bells, or a game at billiards. The man of letters ranks nearly in the same class, and though no one requires moderate and regular exercise more, scarcely any is less inclined to use it. For him, walking or riding in the open air is almost indispensable, to invigorate his body, improve his vision, and relax his mind.

Exercise must be regulated by climate and seasons. Heat and moisture are inimical to it, while a dry and cool atmosphere allows of its being carried to a considerable extent.

As muscular action is thus essential to the preservation of health, rest, or occasional cessation from labour, is not less necessary. The most athletic and robust can continue in motion only for a limited time, and must at last seek repose. By the regular alternations of exertion and rest, the system is invigorated without being exhausted; but the quantity and manner of repose must depend on the previous exertion, and the age, constitution, or other circumstances of the individual. Some persons require hours, and some only minutes, of repose; and while one is sufficiently recruited by sitting, another finds it necessary to recline.

*Sensation.*—A moderate exertion of the external senses, and of the faculties of the mind, is necessary to the enjoyment of health. A person long immured in darkness and silence acquires a morbid sensibility of the whole nervous system, as well as of the visual and auditory organs. Not only are his eyes dazzled by a moderate light, and his ear stunned by ordinary sounds, on revisiting society, but his mind is bewildered, his attention confounded, and his sensibility is tremblingly alive to every impression. On the contrary, when the sensitive organs are exposed to too powerful a stimulus, or when they are too long employed without repose, their sensibility becomes blunted or their actions are deranged. Similar effects are produced on the mind by intense application or overstrained attention, and each of these extremes injures the general health. In early childhood the senses are easily excited, but the mental faculties are developed more slowly. The former should be gradually exercised, and the latter should be employed frequently, but cautiously, and for a short time, till both acquire their full vigour. After that period, till life begins to decline, they may be exercised freely, though not immoderately, only taking care to avoid sudden and violent transitions from repose to exertion.

*Sleep*, that sweet restorer of nature, which gives repose to all the senses, and to all the faculties of the mind, except *imagination*, though necessary to all individuals, is not to all equally necessary in degree or in the manner of enjoying it. Infants ought to sleep for the greater part of the twenty-four hours; childhood and old age require more sleep than youth or manhood. During the prime of life, some persons require eight or nine hours sleep, while others are sufficiently refreshed by five. The manner of sleeping is not less variable. Many persons can sleep very composedly in a chair or a carriage, while others enjoy complete repose only in their bed or couch. The most healthy sleep is procured on a smooth, but not very soft bed, on a hair mattrass rather than a bed of down, in a roomy, lofty, well ventilated chamber, at a distance from noise, and not admitting the glare of light. The bed-clothes should be light, but sufficiently warm to prevent chillness, without too much exciting perspiration. The head should be moderately, but not too much, raised above the level of the body, and the stomach should not be loaded, or the feet cold, before retiring to rest. The sleeper should lie on his side, and the right side is generally preferable, especially after eating. The custom of sleeping during the day, so customary in warm climates, where the evening breeze is so refreshing, is commonly injurious in our temperate regions, and necessary only to certain invalids, or to those who have reduced it to a habit, and even they should follow the example of Augustus Caesar, and doze for a short time in an easy chair. To rise early is proverbially healthy for all those who can use active exertion, but not for the aged or infirm.

Those who are obliged to watch during the hours of night should keep themselves, and especially their feet, moderately warm; should occasionally walk about, and, by way of refreshment, use tea or coffee rather than fermented liquors. A child or delicate adult should not be awakened hastily, and others, on awakening, should not suddenly expose themselves to a strong light or a cold blast of air.

Scarcely any thing conduces more to the preservation of health than the due regulation of *passions* and the *temper*. The exciting passions, such as joy and anger, when suddenly or violently roused, have been known to destroy life; and some of the depressing passions, as grief and despair, if they do not, as often happens, produce the same effect, by leading to suicide, commonly impair the functions of the heart, the stomach, or the lungs, alter the secretions, or bring on permanent insanity. Fear and terror are not less injurious to the health, by exciting fits or fainting, which not unfrequently prove fatal. Keeping the passions in subjection, is, therefore, not less a medical than a moral duty; but for this purpose much will depend on the constitution, and more on the early education of the individual. Temperance, and strengthening the nervous system by air and exercise, will also contribute to the same end.

*Digestion.*—The subject of diet, as far as relates to the healthy adult, has already been anticipated under DIETETICS; but a few remarks must here be added on the diet of children, old persons, and valetudinarians, and on the means of promoting healthy digestion.

The proper food for infants during the first few months of their existence is undoubtedly the mother's milk, and, when that is abundant and nutritious, they require no other sustenance; but, as its quantity may be diminished, or its quality impaired, by many circumstances, it is advisable to accustom the child early to other food once or twice a day. Panada, made of well-baked loaf-bread, fine sea-biscuits, or tops and bottoms, gruel made with groats, and genuine arrow root, all *slightly* sweetened with sugar, and, where the milk is deficient or depraved, mixed with cow's milk, will form a sufficient variety at that early period. If, from any defect in the mother or child, suckling is impracticable, the same substances, with the addition of strong barley water mixed with an equal proportion of cow's milk, and a little sugar, and a dinner of beef tea, and milk and water by way of drink, or whey, if the child be costive, will supply the deficiency. After an infant is weaned, and, at any rate, after it has completed its first year, sooner if not delicate or sucking, it will require more solid nourishment, such as oat-meal porridge with new milk, bread and rice pudding, sago, an egg boiled rather soft, or broth made of lean meat and barley or rice, and eaten with bread. Solid animal food may be given once a day, when the child has cut its first grinders, and is able to take active exercise. Even then all rich and high-seasoned dishes should be forbidden, and the proper drink is water. The quantity of food should be proportioned to the degree of exercise, so as to avoid exhaustion on one hand and surfeit on the other. The times of taking food should be as regular as possible, even in infancy, and they should be more frequent as the child is younger.

As life declines, the power of digestion becomes weaker, and the body requires less nourishment. The food of old persons should therefore be light and easy of digestion, but rather stimulating. Condiments, as mustard, horse-raddish, salt, and Cayenne pepper, are then more necessary, and a moderate quantity of wine or malt liquor is required; but the food should be more sparing than in manhood, and the periods of repast less frequent.

Valetudinarians and literary persons have commonly a weak digestion, and their appetite, though often craving, is, in general, soon satisfied. Their food should be light and digestible, not flatulent, or easily acescent. Bread and milk, or even more solid food, forms a better breakfast for them than tea, and coffee is their best evening refreshment. The proper drink is water, where it agrees, table beer, ginger beer, weak spirits and water, and occasionally a little foreign wine; but, unless they can take much exercise, strong malt liquors are in most cases improper. They should eat often but sparingly at each meal, and should avoid heavy and substantial suppers.

Digestion is promoted by exercise in the air, by wearing a flannel shirt, friction over the region of the stomach with the flesh-brush, a sparing use of fermented or spirituous liquors, by tranquillity of mind, and evenness of temper. Occasional abstinence, by giving rest to the stomach, also conduces to the same end.

*Respiration.*—How much the general health of the system depends on free and healthy respiration, is evident from the numerous evils which attend on an impeded or a disordered state of that function. Giddiness, headache, confusion of intellect, dimness of vision, oppression or pain at the breast, nervous insensibility, or spasmodic affections, suspended animation, or even death, are its usual consequences.

The atmosphere acts upon the system according to its gravity, purity, temperature, dryness, or moisture, and the changes produced in it by winds, electricity, climate, and seasons. A certain range of gravity, as indicated by the barometer, is necessary for health, as, if the air be too dense, it is breathed with difficulty, and, if too rare, it does not sufficiently expand or stimulate the lungs, or produce sufficient pressure on the body. The purity of the air is of more importance. Pure country air, in a situation moderately elevated, whose soil is not marshy, where there is wood enough to furnish shade and shelter from the sun and wind, without obstructing the circulation of the atmosphere, and in the neighbourhood of a clear pebbly brook, and at a distance from mines, foundries, or great chemical manufactories, is the best suited to most constitutions, and the more freely it is enjoyed the better in general is the health. Such an atmosphere is particularly salutary to young children, and to valetudinarians who are not of a consumptive habit Delicate persons with weak lungs, and many old people, breathe more easily in the warmer atmosphere of a small town, with a southern aspect, and sheltered from the north and east by hills or woods. The external air is rendered impure by various exhalations, such as the effluvia from marshes, the smoke from numerous chimnies, or the vapours arising from mines or large chemical manufactories; and an atmosphere thus contaminated must be avoided by delicate persons, and those who have weak lungs. The effects of marsh effluvia may in some measure be counteracted by generous living, warm clothing, and smoking tobacco; and those who are compelled to work in dangerous chemical manufactories, should, if possible, work in a draft of air, so as to blow the vapours from them. Preserving the purity of the air in the dwelling-house is of equal consequence, especially in those apartments where the family reside and sleep. This is best done by having the apartments as spacious and lofty as is consistent with the circumstances of the family, by free ventilation, and by the strictest attention to cleanliness. Ventilation is promoted by having the windows constructed so as to open from above as well as below, by ventilators fixed in the upper sash or casement, by openings in the wall near the ceiling, formed in such a manner as to let out foul air, without admitting a direct current from without, and by occasional fires, while the door of the apartment is partly open. The foul air of crowded apartments and public assemblies is best corrected by the fumes of aromatic vinegar, and its effects may in some measure be avoided by occupying the lower seats in a church, theatre, or ball-room. Nuisances of every kind should be frequently removed, especially from the bed-rooms and nurseries, and beds and bedding should be regularly turned, and aired for some hours, before they are made up for the night; smoky chimnies are very prejudicial to children, valetudinarians, and persons with weak lungs; and where those inconveniencies cannot be remedied, the upper part of an adjacent window should be drawn down during the night, and the chamber door left open.

The range of temperature, within which life and health may be preserved, depends much on habit and constitution; but in general a temperature between 20° and 70° is most conducive to health. The extreme of cold is best counteracted by animal food, a moderate quantity of stimulating liquors, warm clothing, and exercise; and the extreme of heat by a vegetable diet, the use of diluting liquors, and cooling fruits, light cotton clothing, repose during the heat of the day, and moderate exercise in the evening breeze. Warm close apartments are particularly injurious to children and most valetudinarians, but are necessary for old and consumptive persons.

A moist atmosphere, connected either with much heat or cold, is very prejudicial to the health of most persons, and requires flannel clothing, a generous but temperate diet, and a moderate use of spiritous liquors. Damp appartments are even more hurtful than a moist external atmosphere, and can be remedied only by constant fires, and covering the walls during summer with a proper cement that resists moisture. In constructing a dwelling-house, great care should therefore be taken to have a dry foundation, and if possible to build it on a declivity, or where the means of draining may be secured. The extreme of dryness is seldom found in our temperate regions, and in warm climates may be counteracted within doors by using stone or brick floors, and washing them frequently with cold water. In such climates, a dry atmosphere is most to be dreaded when accompanied with great heat and parching winds, the effects of which it is often impossible to avoid.

It is well known that sudden changes of climate and seasons are prejudicial to health, and should therefore be avoided by delicate persons, or counteracted by the means already pointed out under extremes of heat, cold, moisture, and dryness. The constitution of delicate individuals is often affected by particular winds, especially the east, north-east, and north-west, in the climate of Britain. An increased degree of electricity in the atmosphere also affects such persons, and produces various nervous symptoms.

*Excretion.*—Under this head, the regulation of the bowels constitutes the most important object, as on that materially depends the health of the individual. The state of the bowels should be particularly regarded in infancy and childhood, and thus many serious diseases will be avoided or mitigated. An infant should have three or four evacuations, and young children two, in twenty-four hours; and, to establish a habit of regularity in this respect, which will be found of the utmost consequence in after life, children should be early taught to solicit nature after their principal meals, especially after breakfast. The quality of the evacuations should be daily examined, and whenever any unnatural appearance takes place, means should immediately be adopted to correct it. Adults in general require only one healthy evacuation in the day, though that depends much on constitution and habit. The state of the bowels is best regulated by diet and clothing. Persons of a costive habit should live much on vegetable food, and drink malt liquor rather than wine, or spirits and water, and their clothing should be as light and cool as is consistent with the climate and season. On the other hand, persons who have naturally lax bowels should avoid such vegetables as tend to increase that disposition, and use solid animal food, with water, toast and water, wine, and weak grog, for their ordinary drink. To such persons flannel clothing worn next the skin is of great importance, and they should avoid a cold and humid atmosphere.

*The skin.*—The preservation of health depends much on the state of the skin, with respect to cleanliness and defence. The necessity of keeping so extensive a surface clean, soft, and moderately moist, is evident, when we consider the intimate connexion and sympathy between the skin and more important organs, as the lungs, stomach, bowels, and kidneys. The skin of children, in particular, from its great delicacy and sensibility, requires the greatest attention. They should be regularly washed twice a-day, with cold or tepid water, according to the age and season. No soap should be used for infants, and for children white soap alone is proper. They should be plunged every morning in water, cold for stout children, and tepid for such as are delicate. The head of infants should be washed every morning, and then brushed till quite dry. The heads of children who have much hair should seldom be washed, but rather cleaned with the dressing comb and hair-brush, and the small toothed comb should be used cautiously once or twice a-week to remove vermin. The hair of all children should be kept short and thin. A child should be early taught to rinse the mouth after every meal, and when the second set of teeth is completed they should be rubbed gently every morning with the sponge-end of a tooth brush. When the teeth are firm, they may be daily cleaned with a soft brush and water, but tooth-powder is improper for children. Slight excoriations of the skin must be dusted with prepared chalk, and such as are considerable should be dressed with white zinc ointment, but on no account with *white lead*.

For adults very few observations will suffice. In ordinary cases, white soap is preferable to brown, and, where soap is disliked, almond powder, almond paste, and fine oat-meal, are good and safe substitutes. All advertised cosmetics, and all paints, except *rouge*, are dangerous. The frequent use of the tepid bath, and the daily use of the *bidet*, are very conducive to health, and those who have not thick and long hair will find it of advantage to wash the head every morning with cold water. Greasy hair is best cleaned with a solution of carbonate of potash, (*salt of tartar,*) and the same liquid will remove slight incrustations of tartar from the teeth. One of the best tooth-powders, if sparingly used, is fresh burned charcoal finely powdered, or a mixture of that with myrrh and Peruvian bark. Where the skin is dry and liable to crack, the old practice of anointing it with fresh olive oil may be safely adopted.

The clothing of infants should be loose, light, and thin, but warm, and just long enough completely to cover the legs and extend a little beyond the feet. The best materials are cotton and flannel, even during summer, and great care should be taken that they be well dried, and changed as often as they are wet or dirty. Pins should in all cases be avoided. The dress of children must be regulated by the age, sex, and season, but it should never be tight, and should be made of pliable materials. In winter and spring, delicate children should always wear flannel next the skin, but it must be changed oftener than for adults. Grown up persons of a stout and vigorous constitution may dress as suits their taste and inclination; but such as are delicate or consumptive, and those who are exposed to sudden changes of heat and cold, should wear a flannel shirt next the skin, should take off wet clothes as soon as possible, or keep in constant motion till that can be done, and should be particularly careful to avoid wet feet. In most cases, cotton shirts are better than linen.

On this part of the subject, see Armstrong's *Poem on the Art of Preserving Health*, edited by Aiken; Beddoes' *Hygeia*, 3 vols. 8vo.; Willich's *Lectures on Diet and Regimen*; Sinclair's *Code of Health and Longevity*, 4 vols. 8vo.; and Tourtelle *Elemens d' Hygiene*, 2 vols. 8vo.

## PART II. PATHOLOGY.

When the body, or any of its organs, is so affected or deranged as no longer to perform its natural functions in a healthy or easy manner, or when it experiences some uneasy sensation, it is said to be diseased. According to this strict definition, indeed, few persons can be stated to enjoy perfect health; but disease is seldom regarded as present, unless it produce some remarkable effect, and induce the patient to seek relief. When a disease affects the whole system, through the medium of one or more of the functions, especially the circulation, it is called *general;* and it is denominated *local* when it affects only some part or organ, without disordering a whole function. Fevers, extensive or violent inflammations, febrile eruptions, consumption, and many others, belong to the former division,—headach, earach, toothach, colic, calculus, cutaneous eruptions without fever, &c. to the latter. Diseases are also divided into *acute,* or such as run their course in a few days or weeks, and are usually accompanied with fever; and *chronic,* or those which usually continue for a long time, or return at uncertain intervals, and are seldom, or in a slight degree, attended by fever. Again, when a disease attacks many persons at once, or in succession, and appears to spread by infection, or depend on some peculiar state of the atmosphere, it is termed an epidemic;—such are typhus fever, scarlet fever, influenza, and the plague.

The circumstances attending disease, which it is the object of pathology to consider, are the *symptoms,* or those signs of uneasiness, disability, or derangement, which mark the presence of the disease; the *termination,* or the ultimate consequence of the disease, when left to itself, or unsuccessfully treated;—the *diagnosis,* or distinction of similar diseases from each other; the *prognosis,* or the means which skill or experience has suggested of foreseeing the probable event of the disease,—and the *causes,* or those circumstances which precede the actual appearance of the disease. The symptoms and termination constitute the history of the disease, the other circumstances guide the practitioner in treating it. Diagnosis belongs properly to complex diseases, and will be considered with them in the next Part. Prognosis and causes relate both to complex diseases and to the symptoms, and will be best understood in combination with them; but it is necessary, first, to notice the manner in which causes have been distinguished.

The *causes* of diseases are usually divided into three kinds, predisposing, exciting, and proximate. *Predisposing,* or latent causes, are those circumstances which render a person liable to be attacked by disease, though they may remain inactive for an indefinite time, till the appearance of an exciting cause: Such as peculiarities of structure, as of the head, neck, or chest,—hereditary constitution, from gouty, consumptive, or asthmatic parents, though this is commonly referable to structure; and certain morbid states of the body, as debility and fulness of habit. To the same head are also referred age, sex, and temperament. *Exciting,* or evident causes, are those circumstances or events which, acting more immediately on the body, especially when predisposed, tend to produce, or are speedily followed by the disease. To this head belong heat, cold, contagion, accidents, poisons, affections of the mind, and a great variety of others. The *proximate* cause of the disease is, in fact, little more than another name for the disease itself, and as the term is now seldom employed, it requires no illustration.

*Symptoms* have been called *simple* diseases; and though they seldom appear singly, it is proper to examine them separately, before viewing them in combination. The best method of doing so appears to be, to notice them in the order of the functions whose morbid affections they seem to point out.

*Motion.*—The morbid affections of voluntary motion, like those of most other functions, indicate either an increase or a diminution, or a derangement of that function, or of the irritability on which it depends. *Increased voluntary motion* is not a very common symptom of disease, except in insanity; but it occasionally appears in those whose mind is violently affected, and in some nervous diseases, and in hysterical females. It shews great irritability or nervous excitement, but in itself is of little consequence. *Diminished* voluntary motion appears in various degrees, constituting languor, lassitude, muscular weakness, and immobility. The three former are common symptoms of fever and most febrile diseases, especially at their accession, though the third generally continues during their attack. They also accompany *Dyspepsia, Hypochondriasis,* and *Dropsy,* and, when combined with affections of the head, are often the forerunners of palsy, apoplexy, and epilepsy. Languor and lassitude are not, in themselves dangerous, but extreme prostration of strength is, in most cases, a very unfavourable symptom. *Immobility* of some of the voluntary muscles is a symptom of palsy, dangerous in proportion to its obstinacy and extent. All these symptoms depend on the diminution or want of energy, either of the whole nervous system, or of the nerves that supply the part affected. The principal symptoms which indicate a derangement or irregularity of muscular action are tremor, starting, twitching, convulsion, and spasm. *Tremor,* or want of steadiness in the voluntary muscles, is a common symptom of several diseases. It precedes fevers, especially of the intermittent kind. It precedes, and often follows an attack of palsy, and attends that affection of the head in drunkards, usually called brain fever, and commonly follows the painters' colic. When it occurs in the latter stage of acute diseases, it is always an unfavourable, and often a fatal symptom. It seems to arise from an irregular distribution of the nervous powers. *Starting* occurs in teething in children, in cases of worms, and others that are connected with increased irritability. *Twitching,* or what pathologists call *Subsultus tendinum,* is a dangerous symptom, frequent in the last stage of malignant fevers, and other cases where the powers of life are nearly exhausted. It probably arises from sudden, but unnatural excitement, in a debilitated state of the system. *Convulsion,* regarded as a symptom, is a sudden involuntary alternation of contraction and relaxation of the muscles usually subservient to the will, and forms a prominent feature in several of those diseases termed spasmodic, as convulsions, Chorea, epilepsy, Hysteria. It frequently precedes a febrile eruption, and ushers in the fatal termination of several acute diseases, especially Phrenitis and Hydrocephalus. Its prognosis and causes will be given in the next Part, under *Convulsions.* *Spasm* is a sudden and violent contraction of the voluntary muscles, or of some muscular organ, and in its simplest form is called *cramp.* It is a symptom of *Tetanus,* Hydrophobia, Cholera, colic, atonic gout, hooping cough, and some other less formidable diseases. It shews great irritability and strong nervous excitement, and in most cases is a sign of danger, unless it speedily give way to medical treatment. It is most alarming when following punctured wounds.

*Sensation.*—The symptoms referable to sensation are very numerous and important. They relate to the diseased state of the nervous system in general, or to that of the external senses. The symptoms affecting the nervous system are chiefly increased sensibility, diminished sensibility, restlessness, drowsiness, coma, forgetfulness, depraved imagination, and delirium. *Increased sensibility,* or that state of the nervous system in which the patient is tremblingly alive to ordinary impressions, is a distressing, and often dangerous, symptom of several diseases, especially of those low fevers called nervous, Hysteria, Hypochondriasis, Hydrophobia, and Mania. It is most frequent in females, and in males of a delicate frame and sanguine temperament, and usually follows the application of a powerful stimulus affecting the brain or mind. *Diminished sensibility* is the opposite of the former in its subjects and causes, but is often not less dangerous in its result. It takes place in various degrees, as a consequence of gout, rheumatism, and palsy; it accompanies apoplexy, catalepsy, melancholia, and dropsy; is most common in persons of a phlegmatic or melancholic temperament, and shews diminished excitement in the nervous system. It is often found connected with tumours or accumulations of fluid within the head. *Restlessness,* or inability to sleep, is common in the early stage of fevers, where it is dangerous in proportion to its obstinacy, but it is most remarkable in affections of the mind, especially insanity, though, in these cases, it seems not, in itself, so formidable. It appears to depend on increased and unnatural excitement in the brain. An unnatural propensity to sleep, according to its various degrees, of *drowsiness* and *como,* either accompanies several diseases, as the advanced stage of continued fevers, Phrenitis, Hydrocephalus, Erysipelas of the face, apoplexy, Narcotismus,—or it precedes and sometimes follows others, especially some febrile eruptions, palsy, convulsions, and Hysteria. It is dangerous in most acute diseases, according to its degree and continuance. It is probably occasioned by diminished excitement in the brain, produced by causes similar to those of insensibility. *Forgetfulness,* or loss of memory, is a common consequence of severe fevers and of epilepsy, and is sometimes so complete, that the patient has to learn again a language with which before the attack he was perfectly familiar, or cannot retain the remembrance of what passed the preceding day or hour. It is most dangerous in epilepsy. *Depraved imagination* is common during the advanced stage of fevers, and the hot stage of febrile paroxysms. It always occurs in Hysteria and Hypochondriasis, but is most remarkable in insanity. Except in the first and last cases, it is generally a transient symptom, but when obstinate indicates great danger. *Delirium* is an aggravated degree of the preceding symptom, and occurs in the same cases, except that it is not usual to give that name to the depraved imagination of maniacs. It also attends the last stage of violent inflammations, particularly those of the head and chest, and commonly precedes the fatal termination of consumption. It is always more or less a sign of danger, especially in a debilitated system.

Of the morbid affections of the external senses, those of *feeling* claim our first attention. The principal symptoms of disordered feeling are itching, pain, increased heat, excessive cold, numbness, and want of feeling. *Itching* is most common in certain eruptions of the skin, hence called itch, and *prurigo,* and generally attends the disappearance of those febrile eruptions which terminate in desquamation of the cuticle. It is often a distressing symptom in jaundice and worms. Though often extremely troublesome, it is not, in itself, dangerous. It arises from irritation, either immediate or sympathetic, of the cutaneous nerves, and follows the application of various stimuli. *Pain* is one of the most frequent symptoms of disease, and is sometimes, as in *Tic doloureux,* almost the only symptom. It is most remarkable in inflammations, gout, colic, and Tetanus. From the different parts or organs which pain affects, this symptom has received various pathological names; as, *Cephalalgia* for headach; *Otalgia* for earach; *Odontalgia* for toothach; *Pleurodyne* for pain in the side; *Gastrodynia* for stomach-ach; *Enterodynia* for belly-ach, and *Nephralgia,* for pain in the kidneys. *Headach* is very common at the commencement of fevers, Phrenitis, and Hydrocephalus, as a forerunner of hemorrhage from the nose, apoplexy, and Hysteria, and as a concomitant of Dyspepsia. It is a sign of danger when accompanied by a full pulse, flushed face, depraved vision, and singing of the ears. *Earach* is a common attendant on inflamed throat. *Toothach,* when not evidently occasioned by a decayed tooth, is, in females, a pretty sure sign of pregnancy. *Stomach-ach* is a symptom of indigestion or Gastritis, or an approaching hemorrhage from that organ, and *Belly-ach* is a symptom of colic, Enteritis, or worms. Violent and long continued pain is often followed by convulsion, delirium, or coma, and is then a sign of great danger. A sudden cessation of pain, with a weak pulse, after violent inflammation, indicates mortification. Pain is the consequence of so many and various applications and accidents, that it is scarcely possible to give a rational explanation of its occurrence. It is evidently seated in the nerves of the affected part, and may arise from mechanical, chemical, or mental stimuli, such as wounds, punctures, partial compression, the immediate application of acid or acrid substances, poisons, or the sudden effect of passions or mental irritation. *Increased heat* is a common symptom of all fevers, and febrile diseases, including inflammations, febrile eruptions, and active hemorrhages. It is intimately connected with increased action of the circulating and respiratory systems, and might be regarded as a morbid affection of either of those functions, did it not sometimes appear without any disorder of the pulse or breathing. These partial accessions of heat are of little consequence; but violent and long continued febrile heat is an alarming symptom, is generally accompanied with delirium, and followed by coma. The opposite symptom of *excessive cold*, attended with shivering, generally ushers in an attack or paroxysm of fever, especially of the intermittent kind, and is common at the commencement of some inflammations, febrile eruptions, and hemorrhages. It also occurs in the last stages of many acute diseases, and, when joined to a feeble pulse and great debility, indicates gangrene, or approaching death. It seems to depend on a diminished action of the arterial system, as increased heat is probably the result of an opposite state, and may be excited by the direct application of cold to the skin or stomach, when the body is overheated and fatigued, by depressing passions, or by certain *effluvia*. *Numbness* usually precedes and accompanies palsy, and is a common symptom of Angina Pectoris, and swellings in the spinal chord. It is evidently an affection of the nerves, and is usually produced by pressure on those that supply the affected parts. Partial want of feeling is sometimes only a greater degree of numbness, caused by more complete pressure; but it also occurs, in certain diseases of the skin, from a thickness of the cuticle.

*Smelling.*—Few morbid affections are referable to the sense of *smelling*. *Morbid acuteness* of smell occurs in nervous fevers, and other cases where the general sensibility is increased. *Loss of smell* is common in catarrh. *Depraved smell* attends Hysteria and some other nervous affections.

*Tasting.*—Morbid *acuteness of taste* is not common, except when the mouth is inflamed or ulcerated, or the tongue abraded. *Loss of taste* takes place in catarrh, and in fevers when the tongue is parched.—*Depraved taste* is a symptom of indigestion, Hysteria, Chlorosis, jaundice, and worms.

*Hearing.*—Acute hearing, or *intolerance of sound*, is a common symptom of continued fever, *Otitis*, Phrenitis, Hydrocephalus, Hypochondriasis, and Hysteria. *Dulness of hearing* is sometimes the consequence of fevers, severe catarrh, or blows on the head. It sometimes precedes bleeding at the nose. In acute diseases it is generally an unfavourable symptom. *Deafness* sometimes follows severe inflammation and suppuration of the internal ear; but it may be occasioned by accidental injury, and depends either on an obstruction of the passages of the ear, or an affection of the auditory nerve, in which latter case the complaint seldom admits of remedy. One of the most common symptoms of *depraved* hearing is that called *Tinnitus aurium*, ringing or singing of the ears. It occurs in almost all cases where the head is either primarily or sympathetically affected, is frequent in nervous diseases, generally attends partial deafness, and precedes *Epistaxis* and apoplexy. In the last case it is accompanied with fulness and pain in the head, flushing of the face, and throbbing of the temporal arteries, and then only is an alarming symptom. In general, it is the consequence of increased circulation in the arteries of the ear, or partial compression of the nerves; but sometimes depends on a partial obstruction of the passages of the ear.

*Seeing.*—The morbid symptoms of vision are more numerous and important. Morbidly *acute* vision, or intolerance of light, occurs in Phrenitis, Opthalmia, Hydrocephalus, and some nervous diseases. In general, it depends on fulness of the vessels of the eye, and increased sensibility of the optic nerve. *Impaired vision* takes place in many diseases, in the advanced stage of fevers, and the acute inflammations above-mentioned, in Dyspepsia and Hysteria. It is sometimes the consequence of distension of the eye-ball, by an unusual accumulation of the aqueous humour, or of obscuration of the *cornea* from inflammation. *Blindness* will be considered under SURGERY. *Disordered vision*, in various forms, takes place in several diseases. *Squinting* occurs in the last stage of Phrenitis and Hydrocephalus, and indeed in most cases where a fatal effusion takes place within the head. When not habitual it is always a symptom of danger, and is occasioned by unequal pressure or excitation of the optic nerve. The illusive appearance of *sparks*, or lucid spots, before the eyes, is common in Hysteria, and sometimes precedes apoplexy. The still more common illusion of black specks occurs in several nervous diseases, and in the last stage of fevers, when it produces that alarming symptom of picking the bed-clothes. The appearance of phantoms, though rare, is by no means fabulous. It occasionally affects hypochondriacs and hysterical females, and sometimes accompanies delirium in fevers. To this sense is usually referred *Vertigo*, or giddiness, which is a common symptom in several diseases of the head or stomach. It usually precedes vomiting, fainting, bleeding of the nose, apoplexy, epilepsy, and Hysteria, attends the debility of fevers, and follows profuse discharges of blood from the bowels. It is evidently an affection of the brain, and, though generally accompanied with depraved vision, may take place when the power of vision is suspended.

*Digestion.*—The principal morbid affections referable to digestion are, thirst, foulness of the tongue, difficulty of swallowing, inordinate appetite, want of appetite, depraved appetite, flatulence, heartburn, eructation, sickness, rumination, and vomiting.—*Thirst* is one of the most common symptoms of fevers and febrile diseases, and the want of it in such cases, while the other symptoms continue, is a sign of danger. It also accompanies Diabetes, consumption, and some dropsies. In febrile diseases it is owing to diminished secretion, or rapid absorption of the fluids of the mouth and throat, while in the rest it seems to be occasioned rather by a necessary want of fluid to supply what is carried off or diverted from the general mass.—*Foulness of the tongue* is a symptom of fevers, many acute inflammations, especially *Cynanche*, most febrile eruptions, Dyspepsia and consumption. When the incrustation is red, or black and dry, it indicates danger, and its gradual disappearance is a favourable sign.—*Difficulty of swallowing* occurs in inflamed sore throat, Hydrophobia, and some spasmodic affections. It depends on obstruction, from inflammation or spasm, or on palsy of the gullet, and is sometimes an alarming symptom.—*Inordinate appetite* is common in Diabetes and worms, especially tape-worm, and sometimes occurs in Dyspepsia. It is occasioned by the loss of nourishment, or by an unnatural activity of the gastric juice.—*Want of appetite* almost always attends the early stage of acute diseases, and is then a desirable symptom; while in chronic cases it is considered the reverse. It is said to depend on want of *tone* in the stomach.—*Depraved appetite*, or a desire for things that are not nutritious or not wholesome, occurs in Chlorosis, Hysteria, and Mania, and is sometimes owing to acidity in the stomach.—*Flatulence*, so common in Dyspepsia, and all cases connected with weakness of the stomach, is often a very distressing symptom, especially in children, and gives rise to many others, as pain and confusion in the head, *Tinnitus aurium*, and *Vertigo*. It is very common in colic and Hysteria, in which last it is usually called the *hysteric ball*, and then often arises from air swallowed, though it is generally occasioned by the sudden decomposition of undigested food.—*Heartburn*, or a sensation of heat and pain at the pit of the stomach, is another distressing symptom of indigestion, arising from the formation of acid during the decomposition of the food.—*Sickness* or *nausea*, is a symptom of many diseases, both acute and chronic, as at the commencement of fevers, inflammatory affections of the stomach, bowels, and liver, most febrile eruptions, and *Haematemesis*, in atonic gout, and Dyspepsia.—*Eructation* is the consequence of flatulence or heartburn, sometimes of sickness, from a partial contraction of the stomach, throwing up air or fluid into the mouth.—*Rumination*, or the regurgitation and fresh chewing of half-digested food, sometimes attends Dyspepsia, but in general it is a morbid habit.—*Vomiting* usually succeeds sickness in the cases mentioned under that symptom; but is most common in Hydrocephalus, Gastritis, Enteritis, colic, Cholera, and hooping-cough. Obstinate vomiting is a dangerous, and black vomiting a fatal symptom. It is evidently caused by inverted contraction of the fibres of the stomach and gullet, from the application of an unnatural stimulus, mental irritation, or nervous excitement.

*Circulation.*—Many morbid affections belong, or are usually referred to this function, as the morbid varieties of the pulse, palpitation of the heart, Plethora, debility, fainting. When the pulsations of the arteries, commonly felt at the wrist or temple, are more or less numerous in a given time than usual, when they make a greater or less impression on the finger, or when they are irregular in frequency or strength, the circulation is, in general, morbidly affected, and the body is in a state of disease. If the number of pulsations be greater in a minute than in health, the pulse is said to be *frequent*,—if it be fewer, the pulse is slow. A frequent pulse attends the hot stage of fevers, the commencement of most inflammations and febrile eruptions, consumption, and some spasmodic and nervous affections. The pulse is usually slow in the middle stage of Hydrocephalus, in melancholy, Hypochondriasis, apoplexy, and Asphyxia. When the pulsation gives to the finger the sensation of full distension of the vessel, the pulse is said to be *full*, and it is *strong* or *hard* in proportion as it resists the pressure of the finger. When the sensation is that of a diminished stream, the pulse is called *small*, and when it easily yields to pressure it is *weak* or *soft*. The pulse is full and strong at the commencement of inflammatory fever, except in inflammation of the stomach and bowels, in which it is small and hard;—it is full and usually soft in apoplexy and peripneumony;—weak and soft in malignant fevers, putrid sore throat, most dropsies, and the advanced stage of consumption. When a pulsation appears to be lost occasionally in counting, the pulse is said to be intermittent, which, if not constitutional, as is sometimes the case, is often a dangerous symptom, especially in the advanced stage of acute diseases, dropsies, and consumption. It is common and harmless in Dyspepsia and some nervous diseases.

*Palpitation of the heart* is a common symptom of inflammation of the heart or pericardium, of dropsy of the latter, of aneurism of the aorta, and Angina Pectoris. It also occurs in Chlorosis, Hysteria, and Dyspepsia, and is then of little consequence. It is produced by unusual excitement of the heart, or by pressure on that organ from aerial or watery fluid in its vicinity. *Plethora*, or *fulness of habit*, is that state of the body, in which, without any particular disease, the general system seems overloaded, and incapable of its usual activity. It has therefore been called *indirect debility*. In this state, the pulse is usually full and strong, but sometimes languid and oppressed; the face is either florid or bloated, the body generally corpulent, or, if it be lean, the superficial veins are full or prominent; the motions are languid, the mind and spirits dull and heavy, and there is commonly an unusual propensity to sleep. Plethora is not so much a symptom, as a predisposing cause of disease; rendering young and middle aged persons liable to inflammatory fever, gout, hemorrhages, Tetanus, epilepsy, and Hysteria; while it disposes old persons to peripneumony, piles, apoplexy, acute dropsy, and troublesome affections of the skin. It is produced by full and rich diet, and the continued use of strong fermented liquors, with little exercise and a good digestion, by too much sleep, and the want of accustomed evacuations. The opposite state of *debility*, or general weakness, is marked by a weak and generally frequent pulse, a pale or sallow countenance, the body emaciated, or the flesh soft and flabby, the motions feeble and often hurried, and the mind easily agitated. This state predisposes the young and middle-aged to intermittent and typhus fevers, atonic gout, Syncope, Diarrhoea, and scurvy, and in old people it tends to produce chronic rheumatism, palsy, *Haemorrhoea*, and dropsy. It is usually the consequence of insufficient or imperfect nourishment, bodily fatigue or long mental affliction, exposure to cold and damp air, or to marsh effluvia, and profuse evacuations. *Fainting*, or the temporary stopping of the heart's motion, may take place in many diseases, where the body is much debilitated, as in fevers, profuse hemorrhages, in Diarrhoea and Dyspepsia, and is a common symptom of Angina Pectoris. See SYNCOPE in the next Part.

*Respiration.*—Many morbid affections belong to respiration; particularly anxiety, sneezing, cough, hiccup, difficulty of breathing, hooping, crowing, hoarseness, and loss of voice.—*Anxiety*, or oppression at the breast, is generally a very distressing symptom. It occurs in fevers, especially during the cold stage,—at the commencement of inflammations of the heart, lungs, stomach, or liver, in Hypochondriasis, Dyspepsia, Hysteria, and some other nervous affections. It is a sign of danger when extreme and long continued in acute diseases. It is generally the consequence of the action of the lungs and diaphragm being impeded by accumulation of blood or other fluid, or by pressure from below.—*Sneezing* is a sudden and violent expiration, by which the air is forcibly driven through the nostrils. It is common in catarrh, at the commencement of measles, and in worm cases; and is occasioned by irritation of the nerves of the nostrils, eyes, or forehead.—*Cough* is a convulsive and usually reiterated action of the muscles of respiration, forcibly expelling the air through the contracted *glottis*. It is a common attendant on catarrh, croup, inflammation of the chest, lungs, or liver; asthma, measles, hooping cough, consumption, and dropsy of the chest; and occurs in dentition, Dyspepsia, Hysteria, and other nervous diseases. In the former series, it is generally accompanied with expectoration, in the latter it is commonly dry. Violent and long continued coughing is dangerous, especially in plethoric or much debilitated persons, as in the first it tends to produce hemorrhages, suffocation, or apoplexy, and in the others it exhausts the strength, and leads to hectic fever. Cough is usually excited by irritation of the windpipe and its branches, or by sympathy of those parts with the adjacent organs.—*Hiccup*, a convulsive action of the diaphragm, recurring at regular intervals, is seldom alarming, except when it takes place in the last stage of acute diseases, when it generally indicates approaching dissolution.—*Difficulty of breathing*, technically called Dyspnoea, is a very comprehensive term for impeded respiration, which takes place in a great variety of diseases, especially in fevers, inflammation of the chest or lungs, croup, inflammation of the stomach or liver, asthma, hooping-cough, consumption, *Angina Pectoris*, dropsy of the chest, and in the advanced stage of dropsy of the belly. It also occurs in severe Dyspepsia and Hysteria. Sometimes, as in most of the cases just mentioned, both expiration and inspiration are impeded; in some cases, as in croup, the great difficulty appears to be in expiration, occasioning the peculiar symptom of that disease denominated crowing; while in others inspiration is most impeded, occasioning the hooping which gives name to the hooping cough, and which is often experienced in severe catarrh. Sometimes this symptom is accompanied with snoring, especially during sleep, and then the breathing is said to be stertorous. This particularly happens in apoplexy and *Narcotismus*. This symptom, except in asthma, Dyspepsia, and Hysteria, is always more or less dangerous, and particularly so when it obliges the patient to sit in an erect posture, or leaning forward. It is produced by many exciting causes, as an impure atmosphere, accumulation of blood or other fluids within the lungs, the chest, or the belly, constriction of the glottis, contraction of the cavity of the windpipe, from mucus, purulent matter, or preternatural membranes, or pressure of the lungs from accumulation of fat or fluid in their neighbourhood.—*Hoarseness* is a common symptom of catarrh, quinsy, and measles, and often attends hysteric affections. It generally arises from dryness of the throat.—*Aphonia*, or loss of voice, is sometimes only a nervous symptom, and soon goes off; it also occurs in severe catarrh and palsy, but it is most formidable in fevers, where it is almost always a fatal sign. It depends on the want of nervous energy in the vocal organs.

*Secretion and Excretion.*—The most important symptoms referable to these functions are increased secretion of bile, biliary obstruction, *Enuresis*, scanty urine, looseness, costiveness, gripes, and *Tenesmus*. Increased secretion of bile takes place in some fevers, especially the yellow fever, in bilious Diarrhoea and Cholera, and, when not soon checked, becomes a very alarming symptom. Biliary obstruction occurs in Hepatitis, jaundice, and Chlorosis, and, though less speedy in its consequences, is scarcely less dangerous when obstinate. *Enuresis*, or increased flow of urine, is a distinguishing feature of *Diabetes*, and often attends severe attacks of Hysteria, Hypochondriasis, and Dyspepsia, but in these last diseases it is temporary and salutary. *Scanty urine* characterises dropsy, and is common in the heat of fevers and in inflammation of the liver, spleen, and kidney. Copious urine is generally pale, scanty, high coloured; but the varieties of its appearance in different cases cannot properly be explained here. *Looseness* is the principal symptom of Diarrhoea, and will be considered under that disease. Costiveness attends the commencement of most fevers, water in the head, inflammation of the stomach and bowels, colic, Dyspepsia, dysentery, Hypochondriasis, hysterics, jaundice, and several other diseases. It is dangerous in proportion to its obstinacy, and is occasioned by spasm, torpor, or paralysis of the bowels, or a deficiency of these fluids by which they are usually excited. *Gripes* occur in most disorders of the bowels, but are most common in colic, dysentery, and diarhoea. In general, they arise from acid or acrid matters within the bowels, or from flatulence. *Tenesmus*, or straining, may take place in all cases of constipation, but is most common and distressing in dysentery. It is the consequence of a spasmodic constriction of the sphincter muscle of the straight intestine, from unnatural irritation.

*Integumation.*—Many morbid affections shew themselves in the skin and its appendages, as goose-skin, discolouration, spots, pustules, vesicles, desquamation, and baldness. *Goose-skin*, or that peculiar contraction of the skin, in which the hairs stand erect, and their roots form a roughness on the cuticle, is common in the cold stage of fever, and is often produced by cold or terror. It has been attributed to spasm of the extreme vessels, and is evidently connected with want of circulation there. *Discolouration* of the skin appears in yellow fever, Erysipelas, the gum in infants, Chlorosis, inflammation of the liver and jaundice, in most of which it seems to be the consequence of a deposition of bile below the skin. *Spots* of various kinds occur in typhus fever, the plague, scarlet fever, measles, the nettle rush, Lepra, and several other cutaneous diseases, both acute and chronic. The appearance of dark or livid spots in the latter stage of acute diseases, or in a very debilitated constitution, marks great danger. *Pustules* are most remarkable in small-pox, chicken-pox, cow-pox, and the itch, and *vesicles* in *Pemphigus*, Erysipelas, and a variety of chicken-pox. *Desquamation*, or scaling off of the cuticle, takes place in many cutaneous eruptions, especially scarlet fever, measles, and Lepra. *Baldness* is a frequent consequence of fevers and some other acute diseases, and attends Tinea or the scald head in children. It seems to proceed from want of action in the cutaneous vessels, and is often an obstinate symptom.

With respect to their terminations, some general, and many local diseases, after continuing for a certain time, have a natural tendency to terminate in perfect health, or only leave the patient feeble and debilitated. Such are ephemeral fever or weed, regular gout during its early attacks, the mumps, chicken-pox, cow-pox, nettle-rush, bleeding at the nose, piles, asthma in its early attacks, slight jaundice, ear-ach, boils, whitlow, and other slight external inflammations. Others, though in themselves not commonly mortal, tend to produce other and more dangerous diseases, or so much impair the constitution as ultimately to destroy the patient. Of that nature are intermittent fevers, irregular gout, acute rheumatism, measles, spitting of blood, epilepsy, confirmed asthma, hooping cough, diarrhoea, and obstinate or frequently recurring jaundice. But many more, especially continued fevers, plague, inflammations of the brain, chest, or lungs, heart, stomach, liver, or bowels, dysentery, small-pox, scarlet fever, and ulcerated sore throat, croup, Asphyxia, apoplexy, Tetanus, Hydrophobia, colic, Cholera, Angina Pectoris, consumption, and dropsy, when left to themselves, or unsuccessfully treated, commonly terminate in death.

Among the predisposing causes of disease enumerated at the beginning of this part, age and temperament were mentioned; and it is proper to make a few remarks on those causes before proceeding to treat of particular diseases. The different periods of life not only have a considerable influence on the constitution, but produce a liability to particular diseases, either peculiar to those periods, or which are most likely to occur at certain ages. Thus the great irritability and sensibility of infants render them liable to derangements of the biliary system, local eruptions of the skin, especially those called gum and tooth-rush, derangements of the stomach and bowels, sore mouth, and thrush, slight inflammation of the eyes and ears, difficult dentition, and convulsions. Children from two to seven years old are predisposed to remittent fever, acute hydrocepalus, worms, croup, hooping-cough, and those febrile eruptions which seldom occur more than once during life, particularly small-pox, measles, chicken-pox, and scarlet fever. From seven to fourteen, children are liable to most of the diseases first mentioned, and besides fevers, inflammations of the throat, bleeding at the nose, Chorea, and epilepsy. Youth is predisposed to inflammatory affections, scrofula, spitting of blood, consumption, and palpitation of the heart. Middle-age predisposes to most acute diseases, particularly continued fevers, inflammatory affections of the head, throat, chest, and belly, acute rheumatism, gout, dysentery, and Diabetes, to vomiting of blood, piles, many spasmodic diseases, as Tetanus, Hysteria, colic, and Cholera; to Dyspepsia and Hypochondriasis, and to mental alienation. The principal diseases of old age are chronic rheumatism, irregular gout, Peripneumony, Diarrhoea, apoplexy, palsy, dropsy, Calculus, cataract, Hernia, and troublesome eruptions of the skin.

*Temperaments*, or those peculiarities of appearance and habit which distinguish certain classes of persons in the same country, are still divided into four kinds called sanguine, phlegmatic, choleric, and melancholic. The first is characterized by fullness of the superficial vessels, a florid complexion, light hair and eyes, frequency of the pulse, great susceptibility to impressions, and irritability, quickness of intellect, a lively imagination, and copious secretions. Persons of this temperament are peculiarly liable to fevers, inflammations, acute hemorrhages, scrofula, consumption, and spasmodic affections. The phlegmatic temperament is marked by a languid circulation, a slow or feeble pulse, roundness and fullness of the limbs, and a disposition to corpulency, a pale complexion, indolence, want of nervous sensibility, and slowness of apprehension. This temperament predisposes to dropsy and other diseases depending on langour of the circulating and absorbing systems, while it diminishes the liability to febrile, inflammatory, and spasmodic affections. In persons of the choleric temperament the circulation is active, but the superficial vessels in general small, the body is muscular and vigorous, the complexion dark but ruddy, the eyes dark and brilliant, and the mind active, strong, and persevering. They are most liable to nervous diseases, especially violent spasmodic affections, and insanity. In the melancholic temperament, the vessels are large but the circulation slow, though strong; the body is vigorous, but less active than in the choleric; the complexion, hair, and eyes dark, the irritability small, the secretions scanty and not easily increased; nervous susceptibility less than in most of the other temperaments, and the mind slow, but retentive. It is liable to Dyspepsia, Hypochondriasis, melancholy, and jaundice. It must be confessed that persons exactly answering the above description of the temperaments are seldom seen, and that two of them are generally found more or less blended together.

For fuller information on Pathology, the reader is referred to Macbride's *Theory and Practice of Physic*; Gregory's *Conspectus Medicinæ Theoreticæ*, or the English abridgment of that work in the Treatise on Medicine in the Encyclopædia Britannica; Berkenhout's *Symptomatology*; and Parry's *Elements of Pathology*.

## PART III. PRACTICE.

This last division is intended to communicate such information respecting the knowledge and treatment of complicated diseases as may be understood without a medical education. As it is calculated for the use of parents, superintendants of schools, and other heads of families, it will not be expected to contain an account of all the complicated diseases to which the human frame is subject, or to enter into the minutiæ of medical practice. It will be entirely confined to those complaints which occur in Britain and other temperate climates. Many even of those diseases which involve any delicacy of discussion will be omitted, and the treatment will be explained only so far as is consistent with safety and expediency. A prompt and judicious application of remedies will, in many cases, preserve life, or arrest the progress of a dangerous disease; but professional persons alone are qualified to direct and superintend the treatment of complicated and protracted maladies.

Diseases have been variously arranged by different writers on Nosology and the Practice of Physic; but, for all the useful purposes of popular instruction, it is sufficient to distribute them under twelve heads; Fevers, Inflammations, Febrile Eruptions, Hemorrhages, Painful diseases, Spasmodic diseases, Mental diseases, Comatose diseases, General Inabilities, Cahectic diseases, Local diseases, and Accidental diseases.

### CHAP. I. OF FEVERS.

*Fevers*, considered as an order of general diseases, are the most frequent in their occurrence, and the most complicated in their nature, of all maladies. Some or other of them attack all ages and constitutions, and both sexes. They exhibit, during their course, a great variety of symptoms, but are particularly characterised by muscular weakness, increased heat, inability to sleep, loss of appetite, thirst, impaired digestion, frequent pulse, and generally by costiveness and a dry skin. These are the general symptoms which appear in a confirmed attack of fever; but they are preceded by others, such as a sensation of cold, constriction of the skin, shivering, yawning, anxiety or difficulty of breathing, pains of the head, back, and loins, sickness, and sometimes vomiting, which constitute what is called the cold stage of fever, while the symptoms first enumerated belong to the hot stage. In cases where the fever goes off of itself, or yields to proper remedies, the hot stage gradually subsides, the skin becomes moist, the thirst and heat diminish, the pulse becomes less frequent, perspiration takes place, and the other morbid symptoms gradually disappear, leaving only a degree of weakness. Fevers are distinguished into different kinds, according to the mode of attack and the length of their continuance. Some generally attack suddenly, and, after continuing for a certain number of hours, go off entirely for a longer or shorter period, and return again at regular intervals. They are called intermittent fevers. Others make their attack more gradually, and, after continuing for a time, recede for only a short period, and return, or rather increase, after a short interval. Such fevers are generally said to be remittent. A third kind, denominated continued fevers, attack either gradually or suddenly, according to the violence of their exciting causes, and continue, with little or no abatement, for an uncertain time, till they gradually subside, or terminate in the death of the patient.

### SECT. I. *Of Intermittent Fevers.*

The attack, or *paroxysm*, of an intermittent fever is so much alike in the different species, that a general description of it will convey an adequate idea of the disease in all. The first observable symptoms are langour and a sense of weariness, and the person is disposed frequently to yawn and stretch himself; at the same time the skin is pale, the features and whole external surface appears shrunk, and the skin assumes that peculiar appearance called *goose-skin*. The extremities are at this time sensibly cold to the touch, though the patient may not complain of cold; but very soon that sensation is experienced by the sufferer, commencing in the back, and extending over the whole body, and commonly attended with shivering, sickness, and retching or vomiting. It is remarkable, that when the patient begins to feel cold, his skin gives to an observer the sensation of warmth; and after the shivering has continued for an hour or more, the cold is alternated with flushing of heat, till the former entirely ceasing is succeeded by the latter. When the increased heat becomes permanent, the face recovers its usual colour, but soon appears redder than natural, while the features, instead of being shrunk, gradually acquire a greater fullness than before, and the skin in general grows smooth, but continues dry. In the meantime, the pulse, which was at first small and weak, increases in frequency, force, and fullness; thirst, and the other symptoms mentioned as those of the hot stage, appear, and continue till a moisture, commencing in the forehead, gradually diffuses itself over the whole body, till it become a sweat. As the perspiration goes on, the heat, redness, and thirst abate, the pulse returns to its natural standard, and the other functions by degrees resume their ordinary state, and the patient, if in bed, falls into a calm sleep. The whole paroxysm, from the commencement of the cold to the termination of the sweating stage, usually occupies from six to twelve hours, according to the violence of the disease. When the paroxysm ceases, the patient appears for some time to enjoy perfect health, except feeling a degree of weakness, which is increased by repetitions of the attack. In general, after a certain interval, the paroxysm is renewed, commencing about the same time with the preceding paroxysm, and going through the same stages in nearly a similar manner, except that the cold stage successively becomes shorter, and the hot stage longer than at first, and the intervals or intermissions become shorter and less certain. Sometimes, after the disease has continued for several weeks or months, it disappears, but leaves the patient in a very debilitated state, and labouring under some other disease, especially dropsy, which, sooner or later, terminates his existence. In a few cases, the ague itself proves mortal, usually during the hot stage.

At the first commencement of an intermittent fever, it is not easy to distinguish it from a fever of another kind, though this may generally be done by considering the situation and season in which it occurs, and the prevalence or rarity of similar affections. Intermittent fevers are most common in low, fenny, and marshy countries; and, during spring and autumn, occur more frequently in country situations than in towns. They also attack many individuals about the same time; so that, from these circumstances, the nature of the disease can in general be determined by an experienced practitioner; but after several paroxysms have taken place, no doubt can remain on the subject.

In ordinary cases of intermittent fever, especially in Britain, the *prognosis* is generally favourable where the proper medicines are applied, as few instances are there found to prove fatal or very obstinate; but it is otherwise when the causes are violent or permanent, and where the patient has been much debilitated by former diseases, or is exposed to great fatigue or privations, or has been frequently attacked by the same disease, or when he is at a distance from medical advice.

The principal exciting cause of these fevers is the impure exhalation or *miasma* from fens, marshes, and the oozy beds of rivers, though some writers have supposed moist air in general to be capable of producing them under certain circumstances. Debility is the chief predisposing cause, especially when it follows fatigue, poor or unwholesome diet, intemperance, and profuse evacuations. Youth and manhood are more subject to them than childhood or old age. Person who have formerly been attacked, are very liable to a relapse when exposed to damp air or an east wind.

According to the length of the interval which elapses between the commencement of one paroxysm and that of the succeeding, intermittent fevers have been divided into three species, *tertian*, *quartan*, and *quotidian*. The tertian usually returns every other day, or after an interval of 48 hours, and is the most frequent form of intermittents in Britain. The quartan has usually an interval of 72 hours between the paroxysms, or the patient is ill one day, and well or convalescent for two. This is less common. The quotidian returns every day, so that the intervals of convalescence seldom exceed 12 or 18 hours. It is very rare. These distinctions are of importance chiefly to the medical practitioner, as they regulate the treatment to be adopted in the several species.

*The treatment* of intermittent fevers in ordinary cases is very simple. When the symptoms of the cold stage are not very violent, an emetic of ipecacuanha, or emetic tartar, according as the bowels are loose or costive, should be given as early as possible in that stage, and vomiting should be encouraged by drinking moderately of warm chamomile tea. After the operation of the emetic, if the bowels be costive, a purgative of rhubarb and calomel should be taken, and the patient should be put to bed, under a light covering of bed-clothes, in a well ventilated room. When the disease is accompanied with purging, especially if the discharge be bilious, the calomel should be omitted, and 25 or 30 drops of laudanum should be added to the rhubarb. During the hot stage, the patient must be kept as cool and as quiet as possible; thirst must be obviated by drinking moderately of cooling liqours; and if the heat of the body be excessive, it may be allayed by sponging the surface with tepid water. In tertians and quartans it is generally safe to wait till the purgative has produced its effect, and then to begin giving Peruvian bark in powder or strong cold infusion, so that from 40 to 60 grains for an adult may be taken at once, and this is to be repeated if the stomach will bear it, every hour in tertians, and every two hours in quartans, till near the commencement of the next paroxysm. But in quotidians, as the interval is so short, the exhibition of the bark should commence as soon as the hot stage begins to subside, and as much as possible should be taken during the interval. If the bark disagree with the stomach, or excite purging, five drops of laudanum should be added to each dose. During the paroxysm no food is commonly required, and in the interval the food should be light and digestible, but nourishing. When the symptoms of the cold or hot stage are very violent, and when the head or chest is much affected, it may be necessary to bleed before giving an emetic or opiate; but in those, and all other extraordinary cases, nothing should be done without the advice of a practitioner.

On the recurrence of the paroxysm, the emetic must not in general be repeated; but on the approach of the hot fit, a grain of opium, with two or three of calomel will be useful, and the bark must be renewed as soon as the paroxysm is over. When the disease is subdued, change of air, avoiding the exciting cause, temperance, moderate exercise, wearing flannel next the skin, and regulating the bowels, are the best means of preventing a relapse.

Several substances have been mentioned under Materia Medica as substitutes for the Peruvian bark, and where this bark cannot be procured of good quality, or is found too expensive, they may be used in its place. Such are, particularly, willow bark, the horse-chesnut, avens-root, and tormentil. In cases where the bark or its substitutes fail of success, arsenic has been employed with advantage; but its use must not be trusted to inexperienced persons.

### Sect. II. *Of Continued Fevers.*

The continued fevers, common in temperate climates, are chiefly of two kinds, inflammatory fever, and typhus, of which the former is certainly not contagious, while the latter, though it may not always originate in contagion, is propagated by that exciting cause.

*Synocha,* or inflammatory fever, is not often what is called *idiopathic,* that is, it does not in general take place without the accompaniment of some local inflammation, of which it is symptomatic; but as it is occasionally found alone, it is proper to treat of it in this place. The distinguishing symptoms of Synocha are, greatly increased heat, the pulse frequent, strong, and hard, and the urine of a high colour, while the functions of the brain are but little disturbed. This fever differs from all others in having no cold stage. When first observed, it exhibits symptoms of increased excitement in the circulating system; the skin is dry as well as hot, the face flushed, the eyes red and swollen, the tongue foul and dry, the urine scanty, and the other secretions unusually diminished. The sensations are generally more acute than in health, but delirium is not common, except the disease be very violent, or have continued for a long time. If blood be drawn in this fever it shews, on cooling, a buffy coat, that is, the fibrine of the blood collects into a firm dense body, separated from the red particles, and often a little hollow on the upper surface. The duration of the disease is uncertain, and its termination various, though, in general, it runs its course in a few days, and, if not checked in its progress, is followed by an effusion or accumulation of fluid in some parts of the body.

It is not difficult to distinguish Synocha from other fevers when it is once established, especially as it is generally combined with local inflammation. Its prognosis must depend on the violence of its symptoms and exciting causes, but still more on the seat of the accompanying inflammation. Young persons of the sanguine temperament are most liable to this disease; and the principal exciting causes are, exposure to great heat, violent exercise, and sudden intemperance, especially in spiritous liquors. The treatment consists in what is called the *antiphlogistic* plan, of bleeding, purging, abstinence, the use of cooling liquors, and gentle diaphoretics, especially antimonials and neutral salts. The patient must, at the same time, be kept cool and quiet; and where there is a local inflammation its progress must be carefully watched, and treated as mentioned in the next chapter.

*Typhus,* or what has been called putrid fever, malignant fever, the jail distemper, and the hospital or ship fever, is defined by Cullen to be a contagious disease, in which the heat is but little increased, the pulse small, weak, and generally frequent, the functions of the nervous system greatly disturbed, and the general strength much diminished. But so great is the variety of appearances which Typhus fever puts on in different cases, that it is almost impossible to give a description of it which may correspond with any particular case. In general, the first symptoms are general weakness, langour, and lassitude, an inaptitude to motion and exertion of every kind, with occasional shivering, pains in the head, back, and loins, want of appetite, sickness, and sometimes vomiting. Very soon the skin, which was at first rather cold, becomes a little hotter than usual, and either dry or occasionally moistened with partial perspiration; the colour of the face varies frequently between pale and red, and the functions both of body and mind appear greatly impaired; the senses are either blunted or deranged, and low delirium commonly takes place. The bowels are usually costive, and their discharge of a black colour. Often the skin is marked with red spots, which generally indicates a very malignant fever. As the disease advances, the delirium, weakness, derangement of the stomach, and disorder of the senses increase, the tongue appears black and dry, the eyes sunk and insensible to light, the patient catches at invisible objects, especially spots on the bed-clothes, and gradually sinks into coma or convulsions, which terminate his existence. In favourable cases, the heat of the skin abates, and a gentle perspiration diffuses itself over the body; the bowels resume their healthy action; the frequency of the pulse diminishes, and the patient falls into a composed sleep, often of long continuance, and awakes refreshed, but weak; the appetite returns, and is sometimes voracious. The duration of Typhus varies according to circumstances. It is seldom less than a week, or greater than a month. The distinction of this disease from other fevers is sometimes difficult, unless where it is evidently epidemical, and can be traced to its exciting cause. The prognosis will depend on the mildness or the violence of the symptoms, and the ease or difficulty with which they are combated, on the character of the prevailing epidemic, and on the age, situation, and circumstances of the patient; but it is almost always a formidable and suspicious disease, and requires active and skilful treatment. The chief predisposing causes are debility, fatigue, and exposure to cold damp air. It seldom attacks young children, and it is supposed that males are more liable to it than females. It is probable that this disease may be excited by other causes than contagion, such as low or unwholesome diet, impure air, mental affliction, &c.; but in most cases it may be traced to contagion as its exciting cause, and is undoubtedly propagated in that way. In what manner febrile contagion acts upon the body is uncertain; but it is generally received through the medium of the lungs in a contagious atmosphere, or by the skin in touching a fever patient, or wearing infected clothes. It is found that free ventilation, cleanliness, and fumigation with the volatile mineral acids, are the best means of checking the progress of contagion, and preventing its effects.

From the mildness or violence of the symptoms, Typhus has been divided into mild and malignant; and the former is sometimes called nervous fever, the latter putrid fever. The distinction is of little consequence, except that as the latter variety is the more dangerous, it requires more attention on the part of the practitioner and attendants.

In laying down the treatment of Typhus fever, two circumstances are chiefly to be considered,—the reaction of the system marked by the symptoms of increased excitement, such as frequent pulse, increased heat, dry skin, thirst, and costiveness, and the debility consequent to that reaction. In all cases, except where the head is greatly affected, it is safe to begin with the administration of an emetic, and in all, without exception, to give purgatives repeatedly while the increased excitement continues, at the same time that the patient is to be kept cool, in a well ventilated room, with his bed so situated as that the air shall freely circulate round it. He should be debarred from all solid animal food, but allowed the free use of cooling liquors. If the symptoms of excitement be very strong, it is proper to bleed, and a gentle diaphoretic, composed of acetate of ammonia and antimonial wine, may be given three or four times in the twenty-four hours. Where the heat of the body is much above the natural standard, it may be allayed by sponging the body with cold vinegar and water, and, in violent cases, by dashing cold water over it. When the symptoms of excitement abate, and the discharge from the bowels becomes natural, debility must be combated; and this is best done by gradually improving the diet with chicken broth and beef tea, and the cautious use of port wine. If these are found to agree, and the excitement does not return, great hopes may be entertained of a final cure; but the bowels must still be kept moderately open, and ventilation and cleanliness must be strictly observed. In cases where delirium comes on, and still more if coma supervene, a blister should be applied to the back of the neck, and mustard poultices to the feet; but, as has been already remarked, difficult cases and urgent symptoms must be left to the care of the physician.

*The Plague*, improperly ranked among febrile eruptions, is a contagious fever, nearly allied to Typhus, but more violent and more rapid in its course; but, as this terrible disease has long ceased to visit Britain, an account of its progress and treatment, however interesting, is inconsistent with the plan and object of this treatise.

### SECT. III. *Of Anomalous Fevers.*

Certain varieties of fever occasionally present themselves, which cannot strictly be accounted either intermittent or continued, though they are generally referred to one or other of those orders. Such are what have been called remittent fevers, of which the most remarkable is the yellow fever of warm climates; but this, for the reasons already given, must be here omitted. Such, too, is the infantile remittent fever, common among children, which, though it resembles low Typhus in its symptoms, progress, and treatment, is generally believed not to be contagious, and seems to depend rather on a deranged state of the digestive and biliary systems. The disease usually commences with languor, lassitude, loss of appetite; obstinate costiveness, sickness, and vomiting. The face appears pale and distressed, the eyes heavy, and the tongue foul. The belly is generally swollen, and the discharge from the bowels, when procured, of a dark colour, and clayey consistence. Itching of the nose, face, and eyes, induces the child frequently to scratch or pick those parts, and the sleep is disturbed and interrupted with startings or twitching. By degrees fever comes on, and is sometimes very violent, especially at night, though it usually remits towards morning. In favourable cases the fever generally subsides in a few days, and the bowels return to the healthy state; but sometimes the symptoms resist all medical treatment, and the little patient gradually sinks under coma or convulsions. In many cases it is difficult to distinguish this disease from difficult dentition, worms, or water in the head; but in general the appearance of the face, the state of the bowels, and especially the quality of their discharge, with the remitting tendency of the fever, sufficiently mark the distinction. The causes are not well understood, but the disease seems to originate in a derangement of the stomach and bowels, the consequence of improper diet or neglected costiveness. The treatment found most successful is to restore the healthy action of the bowels by repeated and varied purgatives, such as calomel, jalap, castor-oil, aloes, or rhubarb; and if these be rejected by vomiting, to foment the belly and rub it, two or three times a-day with anodyne liniment or ammoniated oil, and give repeated clysters of senna and castor-oil, while calomel, with a little opium, is given by the mouth. The use of internal purgatives must gradually be renewed, and the febrile symptoms combated by free ventilation, cooling drinks, and gentle diaphoretics. When those symptoms abate, and natural evacuations are procured, the strength is to be supported by beef tea and port wine; and when convalescence takes place, it is to be confirmed by nourishing diet, and the use of some simple preparation of iron, such as the comfits sold under the name of steel-carvies, at the same time that the state of the bowels is properly regulated.

*Hectic* is a symptomatic fever attendant on collections of purulent matter, or on a very debilitated state of the constitution, and marked by great weakness, circumscribed flushing of the face, increased heat, chiefly in the palms of the hands and soles of the feet, profuse sweating, especially during the night, and watery purging. It usually comes on in daily paroxysms, commencing in the afternoon, and going off towards morning. In this disease, the powers of digestion are generally but little impaired, or the appetite is sometimes voracious. When it depends on the accumulations of matter it commonly proves fatal, unless the matter be discharged, and the ulcer or abscess healed; but when it depends on mere debility it may generally be cured. The great objects of the treatment are to check the tendency to exhaustion, by checking the purging with astringents and opiates, and diminishing the perspiration by cool air and the use of acids, and to restore the strength by nourishing but not stimulating diet. These objects can, indeed, seldom be obtained, as those remedies which are calculated to remove purging generally increase the tendency to perspiration, and on the contrary the latter remedies usually act in opposition to the former. Something may be done by change of air, and especially by removal to a warmer climate, or to the patient's place of nativity.

## CHAP. II. OF INFLAMMATIONS.

When an external part or organ is affected with pain, swelling, heat, and redness, and is incapable of performing its usual function in a healthy manner, it is said to be *inflamed*; and when the inflammation is extensive or violent, it is accompanied with symptoms of general fever, such as increased heat of the body, thirst, foul tongue, frequent pulse, and restlessness. If pain, heat, and impaired function take place in any *internal* organ, attended with febrile symptoms, it is presumed that the organ is affected with inflammation, though the other obvious marks cannot be observed. Most kinds of inflammation begin with impaired action, and pain or uneasiness in the part affected, and the inflammatory symptoms are gradually followed by fever; but, in some cases, the febrile symptoms are first noticed, and afterwards the inflammatory. In severe inflammations, blood drawn from the veins, when cool, generally exhibits a buffy coat hollowed in the middle.

The progress and termination of inflammation differ according to the nature and seat of the disease. The most common is what is called *phlegmonic* inflammation, which takes place in the cellular membrane, or in glandular or very vascular organs, as the tonsils, the parotid or maxillary glands, the brain, breast, lungs, liver, spleen, or kidney. In this kind, after the inflammatory and febrile symptoms have continued for some time, they gradually abate, and either the disease entirely subsides by what is called *resolution*, or it puts on other appearances. In the part affected is gradually formed a sore, called *abscess*, containing *pus*, or matter, and the part is said to have *suppurated*. The suppuration goes on till the abscess, having attained its full size and distension, bursts, and the matter flows out. If the affected part be external or near the surface, the matter escapes that way, and an open sore or *ulcer* is formed, and with proper care generally soon heals, and the patient is restored to health; but if the organ be internal, and the abscess deep seated, the matter usually flows into the adjoining cavity, or is absorbed from its containing membrane, and the patient is sooner or later carried off by suffocation, coma, or hectic fever. Sometimes inflammation of a glandular organ terminates not in suppuration, but in a hard swelling called *schirrus*; and if this cannot be removed, the disease proves fatal. When inflammation attacks the mucous membranes, as in the nose and bowels, it first produces an increased flow of mucus, whence catarrh and dysentery have been classed as fluxes. When it affects the serous membranes which line the chest and belly and envelope their contents, it is followed by an increased secretion of coagulable lymph, by which adhesions are found after death to have been formed between opposite parts of the membrane. Another termination of inflammation is mortification or *gangrene*, which is frequent in inflammations of the limbs and belly. The consideration of external suppuration, schirrus, and gangrene, belongs to SURGERY; and here it is necessary only to notice the marks by which it may be suspected that any of these terminations have taken place internally. Suppuration may be suspected when the pain gradually subsides or remits, when the pulse becomes soft and slower without being weak, while a sensation of weight and fulness is perceived in the affected part, and its healthy action remains impaired; and if hectic fever or coma supervene, there can be little doubt on the subject. When the pain of the affected part remits, but occasionally returns in a violent degree, while a sense of fulness is experienced, and the healthy action of the part is disturbed, schirrus has probably taken place. When the pain and heat suddenly cease, and the pulse becomes frequent, small, and weak, it may be suspected that mortification has begun. In all these cases, but especially the last, a fatal result may be anticipated.

Inflammations have received different nosological names, according to the part which they attack. Thus inflammation of the brain, or its membranes, is called *Phrenitis*; that of the eye, *Ophthalmia*; of the ear, *Otitis*; of the throat, windpipe, or maxillary glands, *Cynanche*; of the heart, *Carditis*; of the chest or lungs, *Pleuritis*, or *Pneumonia*; of the stomach, *Gastritis*; of the liver, *Hepatitis*; of the spleen, *Splenitis*; of the bowels, *Enteritis*; of the kidney, *Nephritis*; and of the peritoneum, *Peritonitis*. To these will here be added Erysipelas, catarrh, and dysentery; while toothach, gout, and rheumatism, for reasons to be afterwards given, will be removed to the head of painful diseases.

The general diagnosis and prognosis of inflammation may be collected from what has been mentioned above; those of particular kinds will be noticed under their respective heads. The young, middle-aged, and plethoric, are most disposed to inflammation in general. Its exciting causes are numerous; as great heat or cold, or sudden changes from the one to the other, wounds, lacerations, contusions, sprains, intemperance, various poisons, especially of the mineral kind; certain mechanical bodies, as calculous and biliary concretions, and hardened excrement obstructing passages.

In what manner these causes act, or what is the immediate cause of inflammation, medical authors are not agreed. The healthy balance between the general circulation and that of the inflamed part is evidently deranged; and the prevailing opinion is that the latter is impeded, and consequently the blood is accumulated in the affected part, while the general circulation is accelerated.

The treatment of inflammation will depend much on the nature and seat of the inflamed part; but in general the objects to be kept in view are, 1st, to remove, if possible, the exciting causes; 2d, to attempt the resolution of the disease, by restoring the balance of circulation, that is, by lowering the general circulation by bleeding, purging, abstinence, and diaphoretic medicines, and exciting the vessels of the inflamed part by the application of moderate stimuli, as cold, or in some cases heat in the form of fomentation, ammoniated oil or blisters, or by relieving the part of the load by leeches or cupping; 3d, where resolution cannot be effected, and where the part is so situated as to allow a safe escape to the matter, to promote suppuration by warm emollient applications; 4th, when gangrene is inevitable, to promote or effect the separation of the mortified part where it can be done, by stimulating applications or surgical operation, and support the strength of the patient by wine, bark, and nourishing food.

### SECT. I. *Of Inflammations of the Brain.*

True *Phrenitis* is characterized by strong inflammatory fever, acute pain in the head, flushing of the face, redness, and generally fierceness of the eyes, intolerance of light and sound, fierce delirium, and restlessness. The delirium makes its appearance very early, and resembles the raving of mania. This is a very formidable, though fortunately not, in temperate climates, a frequent disease. It runs its course very rapidly, and a few days will decide the fate of the patient. Either the symptoms abate in about four days, and the disease goes off, leaving the patient weak and giddy, or the inflammation extends, an effusion of matter or other fluid takes place within the head, and the patient dies delirious, comatose, or convulsed. Sometimes a bleeding at the nose takes place early, and saves the patient. The inflammation may be seated in the membranes, or in the substance of the brain, but this can be determined only by examination after death.

The young and plethoric are most disposed to

Phrenitis. It may be excited by violent heat, especially that of a vertical sun, by severe blows, and by the immoderate use of ardent spirits. It is to be cured only by copious bleeding, both general and local; cupping the neck, smart purging, blisters, and the continued application of cold water, snow, or ice to the head; while the patient is kept as cool and quiet as possible, in a darkened room, sitting in bed with his head erect.

*Hydrocephalic Phrenitis.*—What is commonly called acute hydrocephalus, or acute water in the head, so common among children, is properly an inflammation of the brain, terminating in a watery effusion. The symptoms vary according to the progress of the disease, which has been divided into three stages. The first stage generally commences with want of appetite, general weakness, langour, listlessness, aversion to exercise, play, or usual occupations, and a propensity to sleep. The eyes are dull and heavy, and the bowels costive. By degrees, symptoms of fever come on, and the patient occasionally complains of pain in the head, and weakness of the eyes, and becomes unusually sensible of light and sound. The eyes are now generally red and watery, the face flushed, the tongue foul, and sometimes red; the bowels either continue costive, or costiveness alternates with looseness, and the stools are green and slimy. In addition to the want of appetite, sickness and vomiting come on. Gradually the pain of the head, sometimes of the neck, becomes more fixed and constant, and the patient either cannot sleep, or sleeps imperfectly, with frequent starting. During this stage the pulse is usually above 20 beats in a minute more frequent than in health. This stage may last from one to three weeks. The second stage is marked by a diminished frequency and irregularity of pulse, while the other symptoms of fever continue; by occasional remissions of headach, though the patient frequently expresses a sense of uneasiness there, by shrieking and putting up the hands to the head; by delirium, or muttering, squinting, or double vision. The vomiting at this time either ceases or occurs but seldom, and either the appetite becomes voracious, or the patient appears to take greedily whatever food is offered. About the end of this stage, which lasts from a day or two to a week, such a complete remission of symptoms often takes place, that the attendants are deceived with a hope of perfect recovery; but the scene is soon changed. In the third stage the pulse suddenly and remarkably increases in frequency, so as scarcely to be counted, and though pretty regular is very feeble; the face is either pale or livid; coma or low delirium come on; the eye-lids are unable to open themselves, and when opened the pupil does not contract, and appears insensible to light. The natural discharges are passed involuntarily, and convulsions of death soon put a period to the suffering of the patient. The whole time of the disease varies from a few days to about a month.

The above is the general course of this terrible disease, to which so many hundreds of children annually become victims; and it is sufficient to put parents on their guard, especially when the following circumstances are considered. Children of from two to twelve years of age, with a large head, and a fair or florid complexion, of full habit and quick passions, are most liable to this disease. The principal exciting causes seem to be great heat, violent exercise, violent and long continued crying, blows on the head, and tumoors within the skull. It is often difficult to distinguish the early symptoms from those which attend difficult dentition or worms; but in general the age of the patient, the progress of the teeth, the state of the bowels, and the degree of fever, will so far guide the judgment as to lead to the prompt application of remedies during the first stage, the only period when they can be useful. The treatment consists in shaving the head, and washing it frequently with cold vinegar and water, applying leeches to the temples, and a blister to the nape of the neck, and, in violent cases, to the top of the head, keeping them open till the symptoms abate, giving brisk purgatives of jalap and calomel, or, if the vomiting be severe, strong purgative clysters, a low vegetable diet, and keeping the patient cool and quiet. If by these means the disease does not speedily take a favourable turn, an experienced practitioner must be sent for.

### SECT. II. *Of Inflammation of the Eye.*

*Opthalmia* is sufficiently distinguished by redness and pain in some parts of the eye, and intolerance of light or dimness of vision; but the symptoms differ according to circumstances. There are two principal species, inflammation of the eye-ball or membranes of the eye, and inflammation of the eye-lids; and each of these may be either acute or chronic. The disease usually begins with itching of the eye; and if it affect the eye-ball or inside of the upper eye-lid, a sensation is usually felt as if a grain of sand, or some other small rough body, had intruded between the ball and lid. In the first species the vessels of the eye-ball are distended with blood, and if the disease be acute, considerable pain is experienced on opening the eye, attended commonly with headach, and more or less fever. In chronic inflammations of the membranes, the pain is less acute, the head little or not at all affected, and there is no fever. In the second species, the eye-lids are generally swelled, especially at the edges, which appear red, and secrete, particularly during the night, a glutinous fluid, which makes the edges of the lids adhere so as with difficulty to be separated in the morning. This species is more commonly chronic than the first. Inflammation of the membranes often proceeds to such an extent as to produce ulcers of the *cornea*, or partial and sometimes total blindness; but, in most cases, both species yield to active remedies.

The young and plethoric are most subject to acute, the old and debilitated to chronic *Opthalmia.* The former is excited by exposure to too strong a light, by cold, by blows on the eye, by the introduction of irritating substances, and sometimes by contagion. The chronic species often follows measles, or attends other eruptions of the face, or is the consequence of general debility. The treatment varies according as the inflammation is acute or chronic. In the former the application of leeches to the temples, and of cooling lotions, such as solutions of sugar-of-lead, or white vitriol, to the eye, brisk purgatives, abstinence, and sometimes blisters behind the ears, commonly succeed in effecting a cure. In the chronic species, stimulating remedies, such as the wine of opium, diluted with solution of acetate of zinc, or the ointment of red oxide of mercury, are usually beneficial.

### SECT. III. *Inflammation of the Throat and Neck.*

Several inflammatory affections, including those of the tonsils, wind-pipe, and parotid glands, have been usually classed together under the general title *cynanche;* but as they differ in their more obvious symptoms, it is better to treat of them apart.

*Inflammation of the tonsils*, or inflammatory sore throat, is a common and well marked disease, distinguished by pain, swelling, and redness of the tonsils, difficulty of swallowing, and more or less of inflammatory fever; and, by these characters, with careful examination of the throat, it may be readily known from a more formidable disease, malignant sore throat, or scarlet fever. The redness of the throat in the former is less bright and less diffused than in the latter, and the difficulty of swallowing is much greater, while the fever is of a different type. When this disease is left to itself, the swelling of the tonsils, sometimes of one, and sometimes of both, gradually increases, till it obstruct both the breathing and swallowing, and a suppuration takes place in the affected part. The tonsil usually bursts of itself, and the matter is discharged by the mouth, or swallowed; but sometimes the swelling is so great as to suffocate the patient, or the same accident occurs by matter falling into the windpipe; but, in general, the disease is not dangerous, and is soon removed by proper remedies. The young, sanguine, and plethoric are most liable to the disease, and its principal exciting cause is exposure to cold after being heated. Those who have once been attacked by it are very liable to a relapse. The treatment consists in an active application of the antiphlogistic plan, by bleeding with leeches applied below the ears, or, if the symptoms be violent, from the arm, repeated purgatives, the employment of blisters to the sides of the neck, and the use of acid gargles. If the febrile symptoms and swelling of the tonsils thus subside, the first gargles may be exchanged for one prepared with vinegar, water, and Cayenne pepper, which will generally prevent a relapse; but if the swelling proceeds to suppuration, this must be encouraged by inhaling the steam of hot water through a tube, and the application of warm poultices to the outside of the neck. Persons subject to this complaint should wear a piece of new flannel immediately round the neck, and bathe the neck every day with salt and water.

Slight cases of sore throat generally yield to purgatives, cooling gargles, and the external use of ammoniate oil spread on flannel.

*Inflammation of the parotid*, commonly called *Mumps*, or *Branks*, is a mild disease, consisting in slight inflammatory fever, with pain and swelling round the ears and below the angles of the lower jaw, subsiding in a few days, and scarcely ever returning in the same individual. It is epidemic, and apparently contagious; commonly attacks children; and requires no other treatment than abstinence, purging, confinement within doors, and guarding the affected parts from cold.

*Inflammation of the wind-pipe* appears in two forms, differing chiefly in the extent of the affection and the age of the persons whom it attacks. One of them is commonly called *croup*, which affects the body of the windpipe, and sometimes extends both upwards and downwards to its appendages. It is almost peculiar to children, and often attacks those of the same family, or in the same local situation, exposed to a cold and damp atmosphere. It is marked by great difficulty of breathing, a hoarse voice, a dry cough, attended with a peculiar ringing noise, which is compared to the crowing of a young cock. It generally begins like a common cold, but soon shews its characteristic symptoms, runs its course very rapidly, and, if not speedily relieved, terminates in suffocation. The other form of this affection has lately received the name *laryngitis*. It is confined chiefly to the top of the windpipe, and the membranes and cartilages that form the larynx, which appear swelled, inflamed, and covered with thick mucus. Both the breathing and swallowing are much affected in this disease, and the termination is more speedy, and, in general, equally fatal with that of croup; but this is a rare disease, and seldom attacks children. The treatment is similar in both forms, but requires to be more speedy and vigorous in the latter. In croup, the application of leeches to the fore part of the neck, followed by that of a large blister, frequent purges, especially of jalap and calomel, and, if the symptoms be very violent, even general bleeding, are chiefly to be relied on. Probably, where the age of the patient will permit, repeated small doses of emetic tartar would have a beneficial effect in lowering the inflammation; but the use of calomel alone, some years ago so highly extolled, is of doubtful efficacy. In laryngitis, the evacuations, especially general and local bleeding, are the chief remedies; but, in both diseases, inhaling the steams of warm vinegar and water is found useful.

### SECT. IV. *Of Catarrh.*

*Catarrh*, or cold, though separated from the present order of diseases by some writers, is strictly inflammatory, and differs from other inflammations chiefly in its consequences, the most remarkable of which is an increased discharge of mucus from the membranes of the nose and throat. It varies much in degree and duration. Sometimes the nose, eyes, and head only are affected, and the disease is then called *a cold in the head*; but more commonly the symptoms extend to the windpipe, and a cough, more or less violent, generally at first dry, and afterwards attended with expectoration of thin mucus, takes place. A slight cold usually terminates in a few days by spontaneous perspiration; but the disease often proceeds to an alarming extent, and may end in suffocation, inflammation of the chest, or consumption. Persons of all ages, and most temperaments, are subject to catarrh; but its chief predisposing cause seems to be plethora, as it is ascertained that those who are exposed to great privations, though the usually exciting causes be present, are seldom affected. The chief exciting cause is a sudden change of temperature, especially sudden exposure to cold when the body is overheated. A slight cold in the head is easily cured by abstinence, purgatives, and confinement to a warm room; but, where the disease is violent, and especially when it is accompanied with severe cough and difficulty of breathing, bleeding and blistering, or the application of a pitch plaster to the breast, may be required. In this case, too, emetics are of great service; and the patient should be confined to bed. A relapse is common, but may in general be prevented by temperance, avoiding sudden changes of temperature, wearing flannel round the neck, and the daily use of cold water to the neck and head.

*Influenza*, or epidemic catarrh, differs from a common cold in being attended by more fever, though not of such an inflammatory nature, and a greater affection of the head, producing headach and giddiness, and in being followed and sometimes accompanied by great weakness and dejection of spirits. It is also more dangerous than the former, particularly to children, debilitated adults, and old people. Though probably not contagious, and depending on a peculiar state of the atmosphere, which sometimes prevails over a great extent of country, it attacks many individuals at the same time, and travels from one county to another. It is therefore epidemic. The treatment of this species is also different from that of the former. Bleeding is seldom necessary, and relief is best obtained by an emetic at the beginning, the application of blisters to the back of the neck or breast, or both, according as the headach or difficulty of breathing requires. The warm bath, or bathing the feet in warm water, is very useful, and the cough may be moderated by extract of henbane, and afterwards by a combination of henbane or opium with ipecacuanha. The patient should be confined to bed; and, when the acute symptoms abate, his strength must be supported by nourishing diet and good white wine.

### SECT. V. *Inflammations of the Chest.*

The pleura, which lines the cavity of the chest, and invests the lungs, is often the seat of inflammation, and the disease is thence called *pleurisy*. Often the inflammation extends to the substance of the lungs, or commences there, when the disease is termed *pneumonia*. The symptoms of both are similar, and are a fixed pain in the side, increased by attempting to make a full inspiration, anxiety, difficulty of breathing, a short, hard, and dry cough, and inflammatory fever. The face is flushed, and the patient is most uneasy when lying, especially on the side least or not affected. If the symptoms do not soon abate, a collection of matter is formed between the pleura and lungs, or within the substance of the latter, and the patient commonly dies either from suffocation or hectic. The young and plethoric are most subject to this disease, and children are not unfrequently attacked by it. Those who have been once affected are very liable to a relapse, and each succeeding attack is more dangerous than the former. Its chief exciting cause is exposure to cold and moist air. It is a very dangerous disease, and requires the most active treatment, as copious bleeding, blisters to the chest, purging, and repeated doses of emetic tartar given in such a quantity as to keep up a constant sickness, without vomiting. This last remedy is here recommended, not as an expectorant, but to diminish excitement, for which purpose it is often very efficacious.

Old persons, and those of middle age whose constitution has been shaken by intemperance, are liable to a variety of pneumonia affecting the substance of the lungs, and marked by less acute symptoms. The variety is commonly called peripneumony. It is a very insidious disease, and often proves fatal before the patient or his attendants are aware of his danger; and it is the more dangerous as the subjects whom it attacks do not readily bear bleeding.

### SECT. VI. *Inflammations of the Belly.*

*Gastritis*, or inflammation of the stomach, is not a frequent disease, except when it occurs from swallowing mineral poisons. It is distinguished by acute and fixed pain in the stomach, great anxiety, constant and distressing vomiting, and acute fever, with a hard, but small, and contracted pulse. Besides the mineral poisons, it may be brought on by blows over the pit of the stomach, drinking copiously of undiluted ardent spirits, or cold water, when the body is heated and fatigued. It is a very dangerous disease, and scarcely yields to any remedy except bleeding till the patient faint, after which the region of the stomach should be fomented for a considerable time with water as hot as the patient can bear.

*Enteritis*, or inflammation of the bowels, resembles Gastritis in the pain, vomiting, hardness, and smallness of the pulse, and the acute fever. The pain is increased by pressure, and the bowels are obstinately costive. This disease is almost equally dangerous with the former, and, like it, when not speedily relieved, terminates in mortification, indicated by a sudden cessation of pain, and sinking of the pulse and vital powers. The disease is excited by most of the causes which produce Gastritis, and, besides, by long exposure of the feet to cold and moisture, and by an accumulation of fœces in the bowels. It is also a common termination of obstinate colic, and is sometimes mistaken for that disease. The marks of distinction will be noticed under colic.—The treatment consists in copious bleeding, hot fomentations to the belly, and repeated warm emollient but not stimulating clysters, and giving mild purgatives, when the pain, fever, and vomiting abate.

*Dysentery*, or bloody-flux, is an inflammatory affection of the bowels, but differs essentially from Enteritis in its seat, symptoms, causes, and treatment. The ordinary symptoms are, griping pains in the bowels, seldom fixed or increased by pressure, costiveness, or at least retention of the natural discharges, accompanied with tenesmus and fever.—The discharge from the bowels consists chiefly of mucus, sometimes tinged with blood, and occasionally hardened fœces are evacuated in lumps. When the disease terminates favourably, it is by a free and natural evacuation of the bowels, and perspiration; but it often proceeds to a great extent, and sometimes proves fatal, by inducing acute inflammation, and destroying the texture of the bowels. Protracted dysentery sometimes ends in weakened and irregular action of the bowels, or in purging. The seat of this disease appears to be the mucous membrane of the intestines. It is most common in autumn, and in marshy situations; but its exciting causes are uncertain. It is not in general a dangerous disease in temperate climates, except to old and debilitated persons. The treatment which has been found most successful, is, first to give an emetic of ipecacuanha, and then repeated doses of some mild purgative, such as castor oil, or Epsom salts dissolved in water, gruel or barley-water, with occasional emollient clysters, while the belly is fomented with hot-water. Bleeding is seldom necessary, but should be employed when the symptoms are violent. In mild cases the above treatment will generally succeed; and when a free discharge from the bowels is procured, perspiration should be excited by the warm bath and the internal use of Dover's powder; and afterwards the strength of the patient is to be restored by nourishing diet and tonic medicines, of which the best for this complaint are Colomba root in powder, and Angustura bark. When the disease is protracted, ipecacuanha, in combination with laudanum, in the proportion of 20 or 25 grains of the former and as many drops of the latter, repeated twice a-day, has been found of great advantage; and where the discharge of mucus is considerable, attended with severe pain, a mixture made by boiling mutton-suet with milk has proved useful. During the treatment, and for some days after, the patient should be clothed in flannel next the skin.

*Hepatitis*, or inflammation of the liver, appears under two forms, acute and chronic, which are usually distinct and well marked. The acute species is distinguished by pain in the right-side below the ribs, increased by pressing the hand on that part, anxiety, dry cough, acute inflammatory fever, and commonly pain at the top of the right shoulder. These symptoms come on suddenly or speedily, and, if not relieved, part of the liver suppurates, and the patient commonly dies of hectic. In the chronic species, the symptoms are less severe, and come on gradually, attended with marks of disordered stomach and bowels, and yellowness of the skin and eyes, and, if not removed, the disease usually terminates in schirrus. In both, a swelling of the liver may generally be felt below the short ribs, and the patient is uneasy when lying on the left side. The first may be produced by most of the exciting causes of internal inflammation already mentioned, and is most successfully treated by bleeding, purging, blisters to the side, and abstinence. The chief exciting causes of the second are long residence in hot climates and the habitual use of spiritous liquors; and it is cured by mercury, the nitric acid, gentle purgatives, and the subsequent employment of tonic remedies.

The other inflammations of the contents or membranes of the belly, including the spleen, kidney, bladder, and peritoneum, are comparatively rare, and the species of *peritonitis* called puerperal fever, which has proved so fatal to lying-in women, does not properly come within the present treatise.

### SECT. VII. *Of Erysipelas.*

Erysipelas, commonly called rose, or St Anthony's fire, forms a natural connecting link between inflammations and febrile eruptions; for though, in violent cases, especially when it affects the face, the disease resembles an eruption, in its more general form, as attacking other parts of the body, it is rather an inflammation. In this last form it is marked by a circumscribed redness, slight swelling, and a burning itching or pain in the affected part, and the redness disappears for an instant after pressure. More or less fever, according to the extent and situation of the affections, takes place, and usually commences with cold, shivering, and sickness. In general, the complaint gradually subsides with a desquamation of the cuticle, but sometimes it ends in mortification. When Erysipelas affects the face, the symptoms and fever are more severe, and are accompanied with considerable pain of the head, swelling of the face and eyes; and vesicles, containing thin acrid matter, soon form upon the skin, and spread over the face and head. These symptoms are often followed by delirium or coma, and prove fatal. But in less violent cases the fever, pain, and swelling gradually subside, the vesicles dry up and scale off, and the patient recovers, though an unnatural redness of the face often remains. The predisposing and exciting causes of this disease are uncertain; but some persons are peculiarly liable to it, and in many instances it may be traced to exposure to cold and moisture. The treatment of the milder form is very simple, consisting in purging, low diet, and defending the affected part from air and moisture, by a light covering of powdered starch or fine meal; but where the fever is acute, and the patient plethoric, it is proper to bleed. In the severer form of erysipelas of the face, great attention is required, and though purgatives are very useful, bleeding is often of doubtful efficacy. The skin must be carefully but lightly protected from the air; and where the head is much affected, a blister should be applied to the back of the neck. But this form must not be left to domestic management.

## CHAP. III. OF FEBRILE ERUPTIONS.

The cutaneous eruptions denominated febrile, technically *Exanthemata*, may be said to form a connecting link between idiopathic fevers and local inflammations. Like the former, they are usually remarkable for the general derangement of the circulating and nervous systems, which either precedes or accompanies the eruption; while, like the latter, they exhibit marks of a local affection more or less extensive and severe, though in most cases the affection of the skin is of only secondary importance. But they are most remarkable for two circumstances, in which the greater number of them agree,—their specific contagious nature, and their occurring but once during the life of the same individual. These characters more particularly apply to the acute febrile eruptions, small-pox, chicken-pox, cow-pox, scarlet-fever, and measles, to which this chapter will be confined. All these run their course within a certain definite time, different in each kind, and in most of them the fever precedes the eruption.

*Variola*, or small-pox, differs in duration and violence, but in general it is more severe when caught by infection in what is called the *natural way*, than when communicated by inoculation. In its milder form it is termed *distinct*, because the eruption then consists of distinct pustules or patches, as the more severe form is said to be *confluent*, because the pustules and patches run into each other. The disease always begins with fever, which in many respects resembles *Typhus*, but at its commencement is marked by more drowsiness, sickness, and coldness, especially of the extremities, by pains on pressing the pit of the stomach, and often by convulsions. The fever usually continues for three or four days before the eruption makes its appearance, first in the face and neck, whence it gradually spreads over the rest of the body. At first the eruption consists of small, hard, red pimples, which, in the course of a day or two, enlarge, and are filled with a fluid, first limpid, then white or yellow, and by degrees thickening and deepening in colour, till it dries up, or flows out by the bursting of the pustules, and forms scabs which, on separating, usually leave hollows or *pits* on the skin. In their progress, they observe nearly the same order in which they appeared. Along with the larger pustules are sometimes smaller ones in patches, and the intermediate skin gradually becomes red, by the extension of red rings which at first only bordered the pustules. The fever continues till the eruption be completed, and is generally in proportion to its extent, and especially to its confluence; but, in mild cases, the fever subsides as the suppuration of the pustules takes place, though what is called secondary fever generally comes on about the eleventh day, when the pustules are numerous and confluent. In general, the whole disease, from the commencement of the fever to the complete desquamation of the scabs, takes up about three weeks. In confluent small-pox, the fever is more like Typhus than in the distinct, generally continues through the whole disease, and may prove fatal by the eleventh day; the head is more affected, and coma more likely to ensue; the suppuration of the pustules is less complete, and the skin between is rather pale than red. In small-pox from inoculation, the fever is usually milder; the pustules less numerous and more distinct, and the duration shorter.

Natural small-pox, once so generally epidemic and so fatal, is now rare, and a comparatively mild disease, and seldom proves fatal, or spreads beyond the house or district in which it appears. Persons of almost all ages, who have not before been attacked by it, or have not been successfully vaccinated, are liable to its attacks; and a few apparently well authenticated cases are recorded, of those who had previously passed through the disease being attacked a second time, and many instances have occurred in which febrile eruption, nearly resembling small-pox, has taken place in families and individuals who had been inoculated. There is reason to think that some of these have been cases of true small-pox succeeding imperfect vaccination, and others small-pox modified and rendered mild by previous vaccination but that most of them must have been cases of aggravated chicken-pox.

When small-pox is not epidemic, it is scarcely possible to distinguish its eruptive fever from those which precede other eruptions, or even from Typhus. The prognosis is generally favourable in distinct, and unfavourable in confluent small-pox, especially when, in the latter, the pustules suddenly shrink and flatten, and the pulse becomes small and weak. The treatment in the former resembles that of idiopathic fever,—purgatives, cool air, cooling liquors, juicy fruits, especially oranges, and low diet constituting the most efficacious plan, which is to be continued till the eruption begins to fade. The confluent variety, when ascertained, must be placed under the direction of a skilful medical practitioner.

In chicken-pox, or *Varicella*, the eruptive fever is seldom severe or of long continuance, and is followed, in two or three days, by an eruption, commencing in the breast, and thence spreading to the face, neck, body, and extremities of distinct vesicles, of a lenticular, conical, or tuberculated form, with a hard inflamed base, gradually filling with a watery fluid, which, after deepening in colour, and sometimes becoming purulent, forms scales that fall off in a few days, seldom leaving pits. It is sometimes difficult to distinguish severe chicken-pox from mild small-pox; and, indeed, some practitioners are of opinion, that the same contagion is capable of producing either disease in different individuals. However this may be, chicken-pox is in general a very mild affection, requiring no other treatment than keeping the bowels open and the body cool, and avoiding all stimulating food.

*Cow-pox*, in its natural form, as arising from contact with an infected cow, is scarcely known, except in large dairy districts. As produced by inoculation, it appears, three or four days after the operation, in the form of a small, hard, red pimple, with an inflamed base, gradually enlarging into a pustule, about the size of a split pea, with a depression in the centre, filled with a whitish, semifluid matter. While the pustule advances, the surrounding inflammation spreads to an inch or more in diameter, and in some cases the eruption is accompanied with slight fever, though in general the febrile symptoms are very mild, or not observable. In about ten days the pustule is at its height, and after that a scab is formed, on the separation of which a pit is usually left in the skin. The success of vaccine inoculation is ascertained by two circumstances; by the presence of fever, which is perhaps the most decisive, or by the simultaneous progress of a second puncture made about five days after the first. In doubtful cases, it is safe to take the earliest opportunity of inoculating with small-pox matter from a healthy person. The experience of 25 years has proved, that the vaccine inoculation, though it does not universally defend the constitution against a subsequent attack of small-pox, tends in a very great degree, to mitigate that attack, and prevent its dangerous consequences.

*Scarlet fever*, and *ulcerated* or *malignant sore* *throat*, are now regarded as the same disease. In its mildest form, it is marked by fever, speedily followed by an eruption of bright red, irregular patches, followed by a scaling off of the cuticle in large pieces, and sometimes by dropsical swelling of the legs. In ordinary cases the fever is pretty severe, and the heat of the body very considerable; the skin assumes the colour of a boiled lobster; the tongue is red, and the throat exhibits a bright red appearance, with swelling of the tonsils and sometimes of the *uvula*; and those parts that become ulcerated are soon covered with thick mucus, and sloughs are formed on them, which separate as the patient recovers. The fever is commonly aggravated during the eruption; the breathing is difficult, but swallowing is commonly easier than in the inflammatory affections of the throat described in the preceding chapter. In the most severe cases, the fever is more acute, and soon puts on the appearance of *Typhus;* the head is much affected, the sloughing of the throat is more extensive, the debility very great, and the colour of the skin, tongue, and throat is darker. These last cases often prove fatal; but, in general, the milder varieties readily yield to proper treatment. It is believed that this disease, in its complete form, scarcely ever attacks the same individual a second time; but its contagion is of a nature so penetrating, that exposure to it often produces a slight affection of the throat, with a little fever, in those who have before experienced its full effects. The disease can be trusted to domestic management only in its milder forms, in which an emetic, repeated purgatives, sponging the body when very hot with cold or tepid water, cool free air, low diet, and fruits, and frequently gargling the throat with water containing muriatic acid, till the sloughs form, and afterwards with vinegar and infusion of Cayenne pepper, will commonly hasten the cure. When the fever is violent, and not resembling Typhus, a single bleeding may be necessary in the early stage; and when the fever subsides, bark and wine are usually given to restore the strength; but these, and all other important circumstances must be left to the judgment of the practitioner.

*Measles*, or *Rubeola*, is distinguished from the other febrile eruptions by its exhibiting symptoms of catarrh at its commencement, and commonly an affection of the chest at its termination. Its usual progress is as follows: The patient is at first restless or uneasy, and, if a child, very fretful and peevish, complains of alternate chills and heats, thirst, want of appetite, sickness, and sometimes vomiting. The eyes are usually weak and watery, sometimes inflamed and impatient of light. Sneezing and running of the nose generally occur, and a cough very commonly appears early, sometimes many days before the eruption, at others not till that has taken place. Adults have a headach, and in children the head is very hot; they are heavy, and sometimes complain of a sore throat. The febrile symptoms are commonly much increased at night, but for the first day or two remit considerably in the morning. The breathing is hurried and oppressed, and a degree of coma frequently takes place. The eruptive fever generally continues three or four days before the eruption is perceived; it is sometimes longer, and in a few cases it lasts only a day or two. The eruption first shews itself on the face and neck, whence it spreads to the arms, hands, thighs, and legs. It appears in the form of small red spots like flea-bites; at first very distinct, but as they become more numerous they run together, and form lines or blotches. They are at first of a faint red, but generally become brighter as the eruption advances, till they gradually grow fainter and disappear. They are in general very superficial, so as scarcely to be felt above the skin, but an attentive observer may perceive a roughness. The eruption is usually fullest on the face, neck, and back. After continuing four or five days, the eruption disappears in the same order in which it came on. It goes off in the form of branny scales, attended with itching of the skin. The fever and affection of the head and eyes are very commonly increased during the continuance of the eruption, and the affection of the eyes sometimes lasts for a long time. The disappearance of the eruption is often followed by a recurrence of the catarrhal symptoms, especially cough and difficulty of breathing, sometimes ending in inflammation of the chest, or leading to consumption. These affections have been called the dregs of the measles, and require particular attention. This disease in its early stages is seldom dangerous, though such a degree of coma may come on during the eruption as to prove fatal, but the catarrhal affection often ends in suffocation.

The above detail of the progress of measles is necessary, because the disease may be mistaken before the eruption comes on for catarrh, and afterwards for scarlet fever. It may, however, generally be distinguished from the former by the greater degree of fever, and the latter by the preceding catarrhal symptoms, and the want of ulceration in the throat. The treatment during the eruptive fever resembles that of Scarlatina, except that here the direct application of cold is inadmissible; for though heat aggravates the fever, and the patient should therefore be kept cool, and his apartment be well ventilated, the application of cold water to the skin would tend to increase the subsequent affection of the chest. Purgatives, low diet, and cooling fruits, are the chief remedies; but where the fever runs high, bleeding is required, and, when the catarrhal symptoms are severe, a blister should be applied to the chest. After the eruption has disappeared the bowels should be kept open, and particular care should be taken to guard against cold.

## CHAP. IV. OF HEMORRHAGIES.

The general diseases called *Hemorrhagies*, or *bleedings*, are effusions of blood from particular organs, which occur independently of external violence, as wounds, blows, or similar accidents. They are sometimes preceded by fever, and have therefore been ranked by systematic writers among febrile diseases. They are generally divided into *active* and *passive*; the former being usually preceded either by febrile or inflammatory symptoms, and producing an effusion of arterial, or at least florid blood; the latter occurring without fever or inflammation, and producing an effusion of venous or dark-coloured blood. To the first head belong *epistaxis*, or bleeding at the nose, and *hæmoptysis*, or spitting of blood; to the second *hæmorrhois*, or piles, and some others, which are here omitted.

*Bleeding at the nose* is commonly preceded by headach, ringing of the ears, and fullness about the forehead and upper part of the nose, and sometimes by shivering or alternate chills and heats. The face is flushed before the bleeding takes place. In most cases the blood flows from only one nostril, generally in rapid drops, but sometimes in a stream; and when the complaint is violent it pours from both nostrils, for a considerable time, so as occasionally to produce fainting. The young, middle-aged, sanguine, and plethoric, are most subject to this disease; and it may be brought on by various exciting causes, such as great heat, violent exercise, violent coughing, sudden intemperance, long stooping of the head, a stoppage of customary evacuations, violent passions, or even intense thought. It is seldom dangerous except when it proceeds to a very great extent, or is frequently repeated, when it may prove fatal from exhaustion, or may terminate in dropsy. This bleeding on its first occurrence, and where it has been preceded by much affection of the head, should not be hastily stopped, as it may prevent a more serious disease; but when violent or often recurring, it may be checked by the application of cold to the head and face, or to the back of the neck, by bleeding at the arm, by purgatives, abstinence, and quiet, by the insertion of styptic or artificial pressure. A relapse may be prevented by avoiding the exciting causes, and particularly by spare diet, abstaining from heating liquors, keeping the bowels open, and the head cool, especially by the use of the shower-bath.

*Spitting of blood* is a more formidable disease than the preceding. It is distinguished by the appearance of the discharge, which is florid and frothy, and by its being generally preceded by coughing, and more commonly than any other hæmorrhage by fever. It sometimes proves fatal from the quantity of blood discharged producing suffocation, but more usually it terminates in pulmonary consumption. Like epistaxis, it occurs most frequently in the young and sanguine, especially in such as have a narrow chest, and are of a scrofulous or consumptive constitution. It may be excited by great heat, violent exercise, intemperance, severe cough, and long or loud speaking, or singing, and in females it not unfrequently takes place instead of another evacuation. The treatment consists chiefly in the use of cool but not cold air, keeping the bowels open by moderate doses of saline purgatives or clysters, vegetable diet, rest, and avoiding all heating or warm liquors, and the other exciting causes of the disease. Bleeding is sometimes necessary, and the internal use of diluted sulphuric acid, and a solution of nitre, is generally thought of advantage. To prevent a relapse, most of the means recommended under epistaxis, except perhaps the shower-bath, must be resorted to; and, besides them, a sea voyage and removal to a milder climate should be advised.

*Piles* are either *blind* or *bleeding*. The former is marked by swellings more or less painful about the fundament, and is usually the effect of costiveness and sedentary habits or occupations; the latter is sometimes the consequence of the former, but more commonly it is a periodical hemorrhage occurring in plethoric persons, especially on the stoppage of some other evacuation. Sometimes the bleeding from the hemorrhoidal vessels is very profuse, and not unfrequently ulceration within the bowels or fistula follows the disease; but, in general, neither variety is attended with immediate danger. Blind piles are removed by evacuating the bowels with mild purgatives, by temperate diet and moderate exercise, and the pain is alleviated by applying an ointment containing finely powdered opium. When hemorrhage comes on, and is profuse, it is to be checked by the means recommended under epistaxis, but in this complaint prevention is better than cure, and persons subject to it should live temperately, keep the bowels moderately open, use regular exercise, especially walking, avoid much sitting, sleep moderately, and lie on a hair mattrass rather than on a feather bed. On the expected approach of another attack, bleeding and purgatives are proper, or leeches may be applied to prevent the rupture of the vessels.

## CHAP. V. OF PAINFUL DISEASES.

Several diseases occur in which pain is the most remarkable and most distressing symptom, and which, from certain peculiarities, cannot, with strict propriety, be arranged either with inflammatory or spasmodic diseases. Of this description are head-ach, when not merely a symptom of some other complaint, tooth-ach, ear-ach, stomach-ach, rheumatism, and gout. The last two, as well as tooth-ach, have indeed been generally classed with inflammations; but they differ essentially from true inflammations, either in often appearing without fever, or in suddenly shifting their place from one limb or organ to another. For these reasons, it is thought proper to treat of them in the present chapter. The last two may be called *general*, and the others *local* painful diseases.

*Head-ach* is often a primary or idiopathic affection, and is then generally called nervous. It varies in extent and degree. Sometimes it appears to occupy the whole head, and even extends to the neck, and is called *Cephalalgia*, when the pain is obtuse, and *Cephalaea*, when it is acute. In many cases it is confined to one side of the head, or appears seated over one eye, when it is called *Hemicrania*, or megrim. Frequently pain is the only symptom of this complaint; but, when very violent, it is often accompanied with fever, foul tongue, intolerance of light, and increased sensibility. In these latter cases, it is very difficult to ascertain whether it be a primary or a sympathic affection; and it is safe to regard it in the latter point of view, as the primary head-ach is seldom dangerous, and often goes off spontaneously, but the same pain is a symptom of many formidable diseases.

Some persons, especially females and literary men, are particularly liable to nervous head-ach; and it may be produced by several exciting causes, as impure or heated air, wet or cold feet, fatigue, affliction, intense application to study, and stoppage of natural or accustomed evacuations. When not connected with the last mentioned cause, it may in general be relieved by smelling salts, or aromatic vinegar drawn up the nostrils, bathing the forehead or temple with hartshorn, or holding over them a piece of cotton wool dipped in ether, by taking strong coffee or volatile tincture of valerian; or, if very violent, by shaving the head, and washing it and the neck with cold vinegar and water, by cupping the back of the neck, or by applying a blister there. If it depend on suppressed evacuations, purgatives or bleeding, or both, will be proper, with abstinence, and bathing the feet in warm water. Persons subject to head-ach should keep the head cool and the feet warm, should live temperately, and attend strictly to the state of the bowels.

*Tooth-ach*, when not connected with pregnancy, is generally occasioned by *caries* of the tooth; and though it may sometimes be relieved by the application of stimuli, as oil of origanum, oil of cloves, or a hot wire, or by chewing certain masticatories, as ginger or pellitory root, is to be cured only by scooping out the caries, and stopping the hole with tin foil or plaster of Paris, or by eradicating the affected tooth. In some cases, a blister behind the ear carries off the pain.

Under this head it is proper to treat of difficult or painful *dentition*. When the gums are unusually tense, hard, and hot, the mouth dry or ulcerated, the face flushed, the bowels costive, and when the child is feverish and restless, or wakes with sudden crying or starting, there is reason to think that such symptoms proceed from irritation of teething. Sometimes a purging comes on and relieves the little patient; but often the above symptoms are followed by convulsions, which not unfrequently prove fatal. This complaint is often not easily distinguished from Hydrocephalus, or the symptoms attending worms and iritation of the bowels; but, in general, the state of the mouth and the progress of the teeth will enable the practitioner to decide. To remove the irritation, the gum must be freely lanced over, and a little in front of, the part where a tooth appears pressing or where it is expected, and that incision must be crossed by another. The child should then be put into a warm bath, and take a brisk purgative of jalap and calomel, or, if there be much sickness, a smart purgative clyster should be administered. If the head be much affected, or spasmodic symptoms appear, leeches should be applied to the back of the neck, and other means mentioned in the next chapter, under *convulsions*, must be adopted.

*Ear-ach*, when not accompanied with inflammation, may in general be relieved by heat, blisters, or inserting within the ear a piece of cotton wool, dipped in laudanum, anodyne liniment, or a mixture of tincture of castor with almond oil.

*Stomach-ach* or *Gastrodynia*, though commonly only symptomatic of several diseases, sometimes takes place to a distressing and even dangerous degree, without any obvious cause. In general, it may be relieved by drinking warm water, or, where there is no fever, warm spirits and water, fomenting the region of the stomach; by an emetic, or, when these means fail, by opium combined with calomel, repeated every hour or two, for two or three times. In obstinate cases, relief has been procured from the oxide of bismuth, given under the eye of the physician.

*Rheumatism* is distinguished into acute and chronic. The first is marked by pain, heat, and sometimes swelling in the part affected, which is usually the shoulder, elbow, loins, hip, or knee, stiffness of the muscles, more or less of acute fever, and by the pain being increased by motion or the heat of bed. In this variety, the pain is apt suddenly to leave the part first affected, and attack another part of the same limb or even a part more remote. If violent or long continued, the stiffness of the limb is increased, or may become permanent, in consequence of thickening, adhesion or effusion near the seat of the affection, or it terminates in the chronic kind. This latter variety has the pain generally less acute but more stationary, and relieved instead of being exasperated by warmth, and it is not accompanied by fever. It commonly attacks old and debilitated persons, while the former, though it be not confined to the young, middle-aged, and vigorous, is more usual among such patients. Winter and spring are the seasons during which rheumatism is most likely to come on; and the usual exciting cause is cold and moisture applied to the body when perspiring and fatigued. Wearing damp clothes, or lying in damp sheets, very commonly produces the disease. On the treatment of acute rheumatism, medical practitioners are not agreed; but perhaps the safest plan, in a domestic view, is to begin with moderate bleeding where the symptoms are severe, then apply a blister to the affected part, and give purgatives, to abstain from animal food and heating liquors, and when the fever abates, if the pain continue, to give a grain of opium with two or three of calomel every six hours for 24 hours, or till within that time the pain abate; after which the Peruvian bark, with a few grains of powdered gum guaicum, mixed with milk, may be given three or four times a day for a few days. In chronic rheumatism the treatment is less doubtful, and consists chiefly in warm bathing, fomentations, friction with ammoniated oil, anodyne liniment, or a mixture of camphorated oil with oil of turpentine, wearing flannel next the skin, and a flannel bandage round the affected part, using as much exercise as the patient can well bear, and nourishing but not stimulating diet, with a dose of Dover's powder at night, followed by white wine whey to promote perspiration, and Peruvian bark through the day to restore strength. After a cure is effected, flannel clothing, the frequent use of the cold bath, regular exercise and temperate living, will in general prevent a relapse. Rheumatism of the loins is generally called *lumbago*, and that of the hip *sciatica*, or hip gout.

*Gout* is the most important of all the painful diseases, both from the distress which its attacks occasion to the patient, and the effects which a repetition of those attacks produce on the constitution. It is distinguished into regular and irregular, or atonic. Regular gout makes its attack in paroxysms, which commonly recur periodically. The paroxysm is preceded by lowness of spirits and indigestion, and a few hours after, usually in the night, severe pain is felt in one or more of the joints, commonly the great toe or wrist, sometimes in the knee. The part affected feels hot, and appears red and swollen as in ordinary inflammations, and there is commonly a degree of general fever. As the disease proceeds, the severity of the pain increases, and the sensibility of the affected part is so great that the patient cannot bear even the pressure of the bed-clothes. When the inflammatory symptoms have taken place, the affection of the stomach goes off, and the spirits rise, but the patient is commonly irritable and very peevish. After the disease has continued a few days or weeks, according to the number of repetitions of the paroxysms, it gradually subsides, and the general health is restored, or even seems better than before the attack. The gout is apt, under certain circumstances, suddenly to leave the part first affected, and attack some other joint or some internal vital organ, when it is said to be retrocedent or repellent, and it is only in these cases that it is generally attended with danger. In irregular gout, the joints are seldom or only slightly affected, and the disease attacks chiefly the internal organs, as the stomach, the head, the heart, or the lungs; and the inflammatory or painful affections of those parts often alternates with symptoms of indigestion. Such cases are always more or less dangerous. A frequent repetition of gouty paroxysms renders the affected joints stiff or immoveable, in consequence of a deposition of what are called chalk-stones, which are found to consist of lithic acid combined with soda.

When gout attacks the larger joints, it is not easily distinguished from rheumatism, and indeed the two diseases are not unfrequently combined; but in ordinary cases, little doubt can be entertained respecting the nature of the disease, where the constitution and habits of the patient are well known. It most commonly attacks young or middle-aged persons of luxurious and indolent habits, and who are descended from gouty parents; and in them it may be brought on by blows or sprains on the part usually affected, or by sudden intemperance, but more commonly it recurs habitually without any obvious exciting cause. The *treatment* of regular gout, during the paroxysm, has, till lately been merely palliative; but reason and experience prove that the symptoms may be mitigated, and the period of suffering abridged, by depletion, abstinence, avoiding heat and irritation, and employing narcotics and diaphoretics. If there be much fever, a single bleeding is proper; if the affected joint be much inflamed, three or four leeches should be applied, and the part should afterwards be *thinly* covered with flannel. A brisk purgative repeated occasionally is very beneficial, and strict abstinence from animal food and *all* fermented or spirituous liquors must be observed, except where the disease becomes retrocedent. When the febrile symptoms abate, and the bowels have been emptied, a grain of opium with two of calomel, given at bedtime, and repeated every six hours for two or three times, will generally relieve the pain, procure rest, and excite a gentle perspiration. When the paroxysm is over, nourishing but not stimulating diet, and the use of bitter tonics, with air and exercise, will contribute to confirm convalescence. A recurrence of the paroxysm is best prevented by temperance and exercise, or, modifying the prescription of the late Dr. Gregory, by "living on a shilling a day, and working for that shilling." Retrocedent and irregular gout must be left to the care of a skilful practitioner.

The celebrated *nostrum* Eau Medicinale, whose active ingredients is supposed by some to be white hellebore, by others *colchicum*, has certainly in many cases carried off a fit of gout sooner than any other remedy; but its effects are often very severe, and it is believed that a paroxysm thus subdued returns earlier; so that it may be doubted whether much real benefit is derived from the use of that medicine, and whether the constitution be not eventually as much injured by the remedy as by the disease.

## CHAP. VI. OF SPASMODIC DISEASES.

Without adopting or rejecting any theory on the nature and effects of spasm, we shall here class together several diseases, in which either a manifest spasmodic action takes place, or the affected organ shews marks of inordinate excitement. They may be divided into *acute* and *chronic;* of which the former run their course more or less rapidly, and, if not relieved, terminate in the death of the patient, as Tetanus, Hydrophobia, hooping-cough, Colic, and Cholera; while the latter, though they may occasionally, and do often eventually put a period to life, generally continue for a long time, or recur in repeated and distant paroxysms, before that event takes place, as asthma, Angina pectoris, convulsions, epilepsy, Hysteria, Chorea, and Diarrhoea.

### SECT. I. *Of Acute Spasmodic Diseases.*

*Tetanus*, commonly called, from one of its symptoms, locked jaw, is a very formidable disease, especially in warm climates, and often proves fatal in a few days. In general it comes on gradually, beginning with stiffness in the muscles of the neck and lower jaw, followed by twitchings, rigidity of the jaw, difficulty of swallowing, and great anxiety. By degrees, the muscles of the trunk and extremities are affected with violent and painful spasm, so that the body is forcibly bent back, and the limbs distorted. These spasms are renewed from time to time till the disease gives way, or the patient sinks from exhaustion or an affection of the heart. If the patient survive four or five days, hopes may be entertained of a recovery, especially if the cause of the disease be obscure. In this climate, it may usually be traced to exposure to cold damp air when the body is heated, and more commonly to a wound or laceration of a nerve or tendon. The treatment which appears to be most successful is first to bleed, where the symptoms are violent, then give brisk purgatives or a strong purgative clyster, and afterwards a grain of opium with two of calomel every two or three hours, while anodyne balsam is rubbed at intervals along the spine. In case of a punctured or lacerated wound, a free incision should be made in it, and it should be dressed with some warm stimulating ointment. The bowels must be kept open during the attack, and port wine should be given to establish the cure.

*Hydrophobia* is one of the most terrible diseases, and is perhaps the most intractable of any with which we are acquainted. It is always the consequence of a wound inflicted by a rabid animal, and may take place at any time within twelve months after the accident. The disease first shews itself by marks of great mental agitation, terror, and anxiety, and soon after occurs difficulty of breathing, and a sense of straitness about the stomach and belly, gradually extending to the throat, and producing difficulty of swallowing, especially liquids. As the disease advances, the repeated attempts to swallow occasion such distressing feelings about the throat, attended with spasms of the neighbouring muscles, that the patient is terrified even at the sight or sound of liquids; thick viscid mucus collects about the mouth and throat, the mind is more and more affected, and the patients sinks from exhaustion or is carried off in convulsions. A few instances of recovery from symptoms resembling those of hydrophobia have been recorded; but it is doubtful whether they really belonged to that disease, and most practitioners are disposed to believe it incurable. Profuse bleeding at first, followed by brisk purgatives, and the subsequent use of opium and calomel, as recommended under Tetanus, only avoiding *friction*, with strict attention to keep the patient as free as possible from all agitation, seem to afford the only chance of cure when the disease has once commenced; but the surest practice is to cut out the bitten part as soon as possible after the bite, and wash the wound with caustic soap ley, and thus prevent the absorption of the poisonous saliva.

*Pertussis*, hooping-cough, or kink-cough, at first resembles a common cough from cold, but, when fully formed, recurs in paroxysms, consisting of a long convulsive cough, followed by a deep and sonorous inspiration or *hoop*, repeated till a quantity of mucus is expectorated, or vomiting takes place, and relief is thus for the time procured. During the continuance of the cough the face is flushed, and sometimes blood issues from the nose, ears, or mouth. When the disease is violent, it is attended with more or less fever and difficulty of breathing; but in general, between the paroxysms, the health appears little disturbed. The complaint usually lasts for several weeks in its acute form, and sometimes continues for months, but it is then chronic or habitual. In favourable cases the convulsive symptoms gradually abate, but the complaint often proves fatal either from suffocation during a paroxysm, or producing inflammation and effusion in the chest, or, lastly, by leading to consumption. Hooping-cough is extremely contagious, and occurs only once during the life of the same individual; but persons of all ages, from the new born infant to the most decrepid old age, are liable to its attack. It is a most uncertain and insidious disease, but is most likely to prove fatal in young and delicate children, and those who have a narrow chest, and are of a scrofulous constitution. The treatment most likely to be successful is to bleed moderately, or apply leeches to the back of the neck, when the symptoms are violent, and a blister to the chest when there is much difficulty of breathing; to promote the natural termination of the paroxysms, by giving a gentle emetic of ipecacuanha, or sulphate of zinc, every morning, and, in some cases, also every evening; and to produce a determination to the skin, by the use of ointment of emetic tartar, or some stimulating liniment or embrocation, such as oil of amber mixed with an equal quantity of olive oil, or Roache's embrocation, rubbed along the spine, and upon the breast, when a blister is not found necessary there. Free air, flannel clothing, and moderation in diet, are also required; and when the complaint appears to become chronic, repeated change of air proves the most effectual means of completing the cure. As to other remedies, especially opium or henbane, in combination with ipecacuanha, to check irritable coughing, they must be left to the judgment of the practitioner.

*Colic* is marked by pain in the bowels, generally referred to the region of the navel, and relieved rather than increased by pressure, attended with costiveness, and at first not accompanied with fever, though, if the pain be violent, the pulse is generally accelerated. Vomiting not unfrequently occurs, and is sometimes severe and bilious. If the complaint be not soon relieved, it is commonly followed by an inflammation of the bowels, and becomes very dangerous, and one variety, the painter's colic is sometimes followed by palsy. In some violent cases, the peristaltic motion of the bowels is inverted, and their contents are thrown up by vomiting, constituting what has been called the *iliac passion*. The principal exciting causes are long continued retention of hardened fœces, the application of cold and moisture, especially to the feet, the introduction of acrid indigestible substances, or of mineral poisons, particularly lead, into the alimentary canal. The distinction between colic and enteritis consists in the want of fever, and the relieving effect of pressure in the former. The treatment will depend on the mildness or violence of the symptoms. Slight colic is in general removed by gentle purgatives, such as caster-oil or Epsom salt, dissolved in gruel or barley-water, by the administration of large purgative clysters, and fomenting the belly with a hot decoction of chamomile flowers and white poppy heads, and afterwards beating the ingredients and laying them hot to the belly by way of poultice; but if the pain be very violent it will be proper to bleed; and if vomiting attend the complaint, a pill, with a grain of opium, and two grains of calomel, should be given once, or more, before using purgatives. This is particularly necessary in the painter's colic, and two or three such repetitions with clysters and fomentations generally remove the spasmodic constriction of the bowels, and prepare the way for the purgative medicines, on which eventually depends the cure of the complaint.

*Cholera*, or *Cholera morbus*, is a disease that indicates an increased action of the biliary system, and is characterized by frequent vomiting and purging of a bilious matter, attended with griping pains of the stomach and bowels, and cramp in the legs, producing great general debility, and running its course very rapidly. It is thus distinguished from bilious diarrhoea, and, by the want of fever, from a variety of tertian, which is sometimes accompanied with similar symptoms. It is most common in this climate during autumn, after excessive heat, which seems to be its principal exciting cause. If not speedily relieved, it generally produces such a degree of exhaustion as to terminate fatally in a few days. The great remedies are, opium given repeatedly, and fomentations to the belly; but before they be used, it is advisable to give diluting mucilaginous drinks, as groat gruel, rice gruel, or barley-water, to clear out the stomach and bowels. When the severe symptoms are subdued, Colomba root, and nourishing diet, with free air, and gentle exercise, will recruit the exhausted system.

### Sect. II. *Of Chronic Spasmodic Diseases.*

*Asthma* occurs in paroxysms, usually preceded by languor, dejection of spirits, loss of appetite, and flatulence. The attack generally commences about midnight, or an hour or two after, with a sudden sense of straitness in the chest, great difficulty of breathing, attended with a wheezing noise, and obliging the patient to sit upright and seek relief from free and cool air, under the dread of immediate suffocation. A dry cough commonly accompanies these symptoms; the face is swelled, the eyes prominent, the countenance distressed, the pulse small and weak; cold sweats break out on the face, and there is often a copious discharge of limpid urine. After the affection has continued for some hours, it gradually subsides, leaving the patient wearied and inclined to sleep. Its decline is usually marked by expectoration of mucus and a return of the urine to its natural state. The paroxysm is sometimes renewed the following night, and then goes off for some days, weeks, or even months; but in general it recurs periodically. As the age of the patient advances, the disease becomes more severe, and continues for a longer time. It may prove suddenly fatal by suffocation, but more commonly it terminates in peripneumony, or hydrothorax. Persons born of asthmatic parents, or having a narrow ill-formed chest, are most liable to this disease, and it may be brought on by any circumstance that irritates or oppresses the lungs, as a dusty, smoky, or foggy atmosphere, severe cough, walking hastily up a hill, or a loaded stomach. The paroxysm is sometimes relieved by a cup of strong coffee, inhaling the steams of hot water, ipecacuanha in nauseating doses, opium, or henbane. It is best prevented or retarded by avoiding the exciting causes, especially repletion and inflation of the stomach, living chiefly on light animal food, riding on horseback, country air, a perpetual blister on the nape of the neck, and taking, for several mornings before the expected paroxysm, a table spoonful of white mustard seed, while the bowels are kept moderately open.

*Angina pectoris* attacks in paroxysm of acute pain in the front of the chest, extending commonly to one arm and shoulder, attended with great anxiety, a quick and small pulse, and faintness, and sometimes producing syncope. The paroxysms recur at uncertain periods, and usually in consequence of bodily exertion or mental agitation, especially walking up hill, and violent passion. It appears to be a spasmodic affection of the heart, and dissection has shown that it is generally connected with ossification of some of the valves of that organ. It is a very dangerous disease, and sooner or later always proves fatal. Persons who are past middle age, and are of a full corpulent habit, are its victims. All that can probably be done to relieve this distressing affection is, to keep the patient as quiet as possible during the attack, and afterwards to avoid the exciting causes, observe temperance, keep the bowels easy, and maintain an issue or perpetual blister in the left side or arm, or rub the breast with ointment of emetic tartar to keep up a succession of pustules.

*Convulsions*, though seldom strictly idiopathic or a primary affection, are so formidable as to require a place among complicated diseases. They vary much in appearance and degree, sometimes attacking suddenly, but more commonly coming on by degrees, or being preceded by symptoms which, to an experienced observer, give notice of their approach. Slight convulsions, such as the affection of infants, called inward fits, are marked by twitching of the limbs, distortion of the features, resembling a smile, discolouration of the face, and fixing of the eyes, with the lids half open. Greater degrees are sometimes preceded by heaviness, restlessness, great irritability, or an unusual appearance of terror; sometimes by an unnatural sprightliness or high spirits, without an adequate cause. In a few cases they are preceded, for some hours, by blueness about the mouth and nose, working of the lips, and an appearance of sickness. When the fit comes on, the patient, if standing or sitting, generally falls down; if a child in arms, he suddenly throws himself back, the features are fixed, the eyes distorted, and the hands clenched; and these appearances are speedily followed by a general convulsive motion of the limbs or the whole body. When this has lasted for some time, the patient usually falls into a state of insensibility, appears drowsy, or becomes comatose. In other cases, the convulsion goes off with violent screaming, and an appearance of great terror. Though this disease does not often prove fatal till after many repeated attacks, it is always to be regarded with suspicion. The patient may be carried off in one of the fits, or he may sink into a state of incurable coma, or the disease may degenerate into atrophy or hydrocephalus. The causes are often obscure; but, in general, persons of what is called the nervous temperament, or those who have a mishapen head, and especially children of this description, are most subject to it. The principal exciting causes are derangement or irritation of the stomach or bowels, especially from worms and costiveness, painful dentition, sudden fright or passion, accumulation of blood within the head, or tumors pressing on the brain. The indications of cure are, to shorten the fit, and prevent its return. Slight convulsive fits are generally removed by the warm bath, friction with ammoniated oil, or some other stimulant, along the spine, and giving a brisk clyster. If the fit be severe, and the face flushed, it is better to avoid the general warm bath, and to place the feet in warm water, while the head and face are bathed with cold water, or it may be necessary to pour the cold water on these parts in a continued stream. In all cases the body should be placed in a half erect posture, and the clothes should be untied, and, where bathing is required, taken off as speedily as possible. In children who are cutting teeth, it is a safe practice to lance the gum wherever a tooth appears prominent, or is expected. After the convulsion is over, if coma supervene, if the face be flushed, or the head appear much affected, leeches should be applied to the back of the neck, the hair should be cut close, or the head shaved and occasionally bathed with cold water and vinegar. Where the stomach or bowels are disordered, a brisk purgative of jalap and calomel should be given as soon as the patient can swallow. To prevent a recurrence of the fit, the evident exciting causes must be avoided; the head must be kept cool, and the bowels regular; the diet must be light, and of easy digestion; and the daily use of the shower-bath will be advisable. Where the exciting cause is obscure, or where there is reason to suspect some affection of the head, it is proper to maintain an issue or perpetual blister in the nape of the neck, or to rub that part occasionally for two or three days with ointment of emetic tartar.

*Epilepsy*, or *falling sickness*, is so nearly allied to convulsions in its appearance, causes, and treatment, that after the above full account of the one, the other may be very briefly discussed. Epilepsy generally attacks in sudden paroxysms. The patient appears confused and stupid, and, if standing or walking falls down, becomes generally convulsed, with closed or staring eyes, and foaming mouth. To these symptoms succeed insensibility and loss of motion; and, on recovery, the patient seems unconscious of what has happened. The paroxysm often returns periodically, but more commonly after an uncertain interval. In young persons, the disease sometimes disappears entirely after puberty; but if it come on or continue after that period, it commonly remains for life, and produces fatuity. The fit is sometimes preceded by some of the symptoms mentioned under convulsions, or by the sensation of cold proceeding from some part of the body to the head. Epilepsy may be produced by most of the exciting causes of convulsions, and not uncommonly follows long or frequent intoxication. The treatment of the disease is still imperfect. When warning is given of an approaching fit, it may sometimes be prevented or checked by a sudden exertion on the part of the patient, or by holding or stopping the breathing for an instant. When a fit takes place, the clothes should immediately be loosened, and the patient should be raised into a half-sitting posture, and exposed to free air, while his face and head are washed with cold water. The subsequent treatment resembles that of convulsions; but in addition to these means, certain tonics, as oxide of zinc, ammoniaret of copper, and nitrate of silver, have been employed with various success.

*Hysteria* appears under a great variety of forms or degrees. It is sometimes marked only by great irritability and sensibility, a shortness of temper, and a propensity to continual motion, accompanied with a sensation of wind rising from the bowels or stomach, like a ball, till it reach the throat, where it produces a feeling as if suffocation would take place. At other times it shews itself by alternate fits of crying and laughing without any obvious cause, or only as the consequence of sudden emotion. In its severest form it resembles an epileptic fit, except that the patient is to a certain degree conscious of what passes, and, on recovering, has a pretty perfect recollection of her late situation. The fit generally goes off with violent irructations, crying, and a copious discharge of limpid urine. In no disease except insanity is the mind more affected, and, in particular, the patient labours under the terror of approaching death. The disease seldom proves fatal, but it sometimes terminates in epilepsy. Young females of the nervous temperament, or born of hysterical mothers, are particularly liable to this complaint, especially at certain critical periods; but males are not entirely exempt from it. It is brought on by most of the exciting causes that produce other spasmodic affections, and seems to depend very much on the deranged state of the stomach and bowels. The paroxysm is moderated by free air, the application of cold water to the head, neck, and face; an erect posture, and some gentle stimulating medicine, as volatile tincture of valerian, or tincture of assafoetida; but if the convulsions be strong, and the face flushed, bleeding will be proper. After the fit is over, the bowels should be freely opened, and the patient kept as quiet as possible, both in body and mind. A recurrence of the disease is best prevented by temperance, regulating the state of the bowels, exercise, change of air, the shower-bath, and moderate exhilaration of the mind.

*Chorea*, or *St Vitus' Dance*, is a peculiar nervous affection, occurring chiefly in children who are cutting their second set of teeth, or between the commencement of that period and puberty, though it may continue longer. It is distinguished by strange gesticulations or irregular motions of the limbs, generally of the arm and leg of one side, which take place when the patient begins to move, or during walking. The causes are obscure, but the disease is evidently rendered worse by irritation of the teeth, or a derangement of the stomach and bowels, and appears to be connected with debility. The most successful treatment seems to be to open the bowels freely by repeated purgatives, and then to strengthen the general habit by the usual tonic medicines, nourishing diet, the cold bath, free air, and regular exercise. Frictions along the spine, or the application there of repeated blisters or issues, is also found of service.

*Diarrhœa*, or purging, considered as a primary disease, varies according to the nature and appearance of the discharge. In ordinary cases that discharge consists merely of excrementitious matter, rendered unusually liquid by being mixed with the fluid supplied by the exhalant vessels of the bowels, and it is there called *stercorous*; but in other cases those matters are either mixed with a great proportion of mucus, constituting *mucous D.* In another variety, more or less of bile is mixed with the discharge, giving it a dark colour and a peculiar offensive odour, and this variety is termed *bilious D.*—The first kind is the most common and least dangerous; the second shows great irritation of the bowels, and, especially in children, is often an alarming complaint; the third, if not soon checked, produces great debility, and is sometimes equally fatal with cholera. When stercorous diarrhœa is long protracted, it is apt to degenerate into what is called *lientery*, in which the aliment is passed in a crude and undigested state, showing great weakness and derangement of the digestive organs. The two former varieties are often accompanied with gripes; and in the last, nausea and a bitter taste in the mouth, with a slight degree of fever, are common symptoms, and fainting not unusually occurs. Obstinate purging produces great debility and emaciation, and sometimes terminates in dropsy. The most frequent causes of common diarrhœa are, exposure to cold, unwholesome or not easily digestible food, especially meat or fish in a putrescent state, very sweet or acid malt liquors, putrid odours, and irritation from teething, worms, or long retained fœces. The treatment differs according to the nature of the discharge. Stercorous D. should not be hastily or suddenly checked, as it often prevents worse complaints; but mild, diluent, or mucilaginous liquors should be given freely, while gripes are counteracted by the application of heat to the belly, and taking some aromatic stimulant, as ginger or cinnamon-water, and supporting the strength with beef-tea or barley-broth without vegetables. If, under this regimen, the purging continue, it is to be moderated by confining the diet to solid animal food, and toast and water, or weak brandy and water; promoting perspiration, by wearing flannel, bathing the feet, and lying in bed; or by repeated doses of toasted rhubarb, prepared chalk, and powdered cinnamon. Should these means prove too weak, recourse must be had to chalk mixture, with laudanum or electuary of catechu, or clysters of beef-tea or starch, with fifty or sixty drops of laudanum. Afterwards the stomach and bowels are to be strengthened by tonics and aromatics, particularly Colomba, Angustura, and ginger. In mucous D. where the fœces are partially or wholly retained, gentle purgatives, as castor-oil and emollient clysters, must first be employed, and then rhubarb and Colomba, with beef-tea and rice-gruel, and, if the mucous discharge continue, clysters of starch and laudanum. Bilious D. must be treated much in the manner already recommended for cholera, into which it is apt to degenerate. The above remarks apply to the complaint as it appears in young persons and adults. Diarrhœa in infants and children, when severe, and not easily yielding to simple means, should be submitted to the care of a skilful practitioner, as it is sometimes a very dangerous disease, and requires prompt and varied treatment.

## CHAP. VII. OF MENTAL DISEASES.

The *Vesaniæ*, or mental diseases, have usually been divided into three kinds: *Mania*, or raving madness; *Melancholia*, or melancholy madness; and *Amentia*, or fatuity. But as the two former are intimately connected, and commonly alternate with each other, it is better to combine them under the general term *Insanity*, to which this chapter will be confined. It is often difficult, if not impossible, to determine whether a person be really insane, or only labouring under some high excitement or extreme depression. True madness is said to consist in a derangement of the mental faculties, unaccompanied by fever, and not followed by coma; but many cases occur in which most of the mental faculties, as the memory, judgment, and even reason, seem not only entire, but sometimes more than usually acute. In general the imagination is most affected, and the reasoning powers err respecting some particular topic, which seems to engross the thoughts of the patient. Mad persons usually bear pain, cold, hunger, and want of sleep better than others, and require much larger doses of evacuating medicines and of opium to produce the desired effect; and some of them endure incredible fatigue, with apparent impunity. At the same time they are easily intimidated, and readily submit to those who have acquired an influence over them.

A fit of insanity is often preceded by oppression at the stomach, want of appetite, or distaste of ordinary food; thirst, restlessness, dread of some approaching danger, and an unusual antipathy to certain persons or objects. These symptoms either end in profound melancholy, long silence, aversion to all exertion, and perfect indifference to all around, or they give place to immoderate mirth, incessant talking or singing, abusive, indecent, or blasphemous language, furious rage, and a constant desire of motion. In most cases these opposite states of excitement and depression alternate till a lucid interval take place. The duration of the whole fit is uncertain, but it commonly returns periodically.—Since the medical treatment of insanity has been better understood, its prognosis is not considered so unfavourable as formerly. Many cases, once thought desperate, have been cured, but the event is always doubtful, especially in settled melancholy. Persons born of parents subject to insanity, of the melancholic temperament, and between 20 and 40 years of age, are most liable to that disease. Particular employments, in which the imagination is much concerned, as painting, poetry, and music, have also been accused of predisposing to insanity. The most obvious exciting causes are sudden emotions of anger, joy, or grief, continued intoxication, especially with ardent spirits, and fanaticism or superstitious fear. The domestic treatment, which alone can be touched on here, must be varied according as the symptoms shew excitement or depression. In the former, soothing conduct on the part of children and domestics, and firmness, without severity, from parents or superiors; strong purgatives if the bowels be costive, low diet, with cooling acidulous liquors, cool air, cutting the hair close, and washing the head and neck frequently with cold water, and seclusion from all society except the family, will in general mitigate the symptoms. If coercion be found necessary to prevent the patient from injuring himself or others, the strait waistcoat, or confinement to bed, with the assistance of proper straps, under the direction of a keeper, must be employed till the patient can be removed to a lunatic asylum. In the melancholy stage, much benefit may often be derived from the kind attention of the family, in endeavouring to divert the patient, by cheerful conversation, amusing games, lively music, frequent change of air and scene, the warm bath, light diet, with a moderate allowance of wine, keeping the bowels regular, and constant vigilance to prevent suicide or other personal injury.

## Chap. VIII. Of Comatose Diseases.

The various species of apoplexy and palsy, constitute the diseases usually denominated comatose; but as the latter often appears without having been preceded by coma, and forms a natural link between the *Comata* and the inabilities, it is here thought proper to place it at the head of the following chapter.

In *Apoplexy*, sensation and voluntary motion are suddenly suspended, while circulation and respiration continue, and the patient lies in a state of coma. The pulse is usually full and slow, the breathing slow and stertorous, the face flushed or livid, and the eyes insensible to light. The pulse is sometimes weak, and the face pale. A fit of apoplexy is often preceded by headach, flushing of the face, fulness of the vessels of the neck, giddiness, sickness, ringing of the ears, dimness of vision, or the appearance of specks or spots before the eyes, and numbness of the limbs. When left to itself, or not speedily removed by art, the disease generally terminates fatally, or, on going off, leaves the patient paralytic. In the former case, an effusion of blood, or serous fluid, is found to have taken place within the head. From what has been observed, it appears that the prognosis in apoplexy is generally unfavourable, and it is more so according to the advanced age of the patient and the number of attacks he has experienced. Persons above the middle age, with large head and short neck, of corpulent body, and indolent or studious habits, and addicted to gluttony and intemperance, are most liable to the disease, and in them a fit may be brought on by many exciting causes, as heated and impure air, sudden emotions of joy or anger, repletion of the stomach, repeated intoxication, violent exercise or labour, sudden ceasing of customary evacuations, long stooping of the head, and intense study. It may also be the consequence of certain narcotic poisons, as opium, and of excessive cold; but such cases will be described in a subsequent chapter. When the preceding symptoms already enumerated appear in a person predisposed to apoplexy, a fit may in general be prevented by bleeding, purging, abstinence, quiet, and avoiding the exciting causes.—When a fit occurs, the patient's clothes, especially all tight parts, must be loosened, and he should be placed in a cool well aired apartment, in a half-sitting posture. He should then be copiously bled, if possible, from the jugular vein, and a strong purgative clyster should be administered. In the mean time the head should be shaved and washed with cold vinegar and water, and a large strong blister should be applied over it, or to the nape of the neck. If by these means sensation be restored, a purgative medicine should be given so as to open the bowels freely. The diet should for some time be low, and a complete abstinence from all fermented and heating liquors must be observed. If the head continue affected, the blister on the neck must be kept open, and the occasional use of purgatives should be continued. Those who are strongly predisposed to apoplexy can prevent what would probably be a fatal relapse only by a strict attention to temperance, and moderation in all other respects, and by avoiding the exciting causes already enumerated.

## Chap. IX. Of General Inabilities.

In the present chapter are to be considered certain general diseases, attended with debility, as Palsy, Syncope, Dyspepsia, Hypochondriasis, Asthenia.

*Palsy* consists in a loss or diminution of power in some of the voluntary muscles, or in a want of steadiness in those muscles, shewn by shaking or trembling of some particular limb or organ. Thus it appears in various degress, from the trembling hand or nodding head of the debilitated and decrepid, to the complete loss of motion of great part of the body. In those palsies which follow apoplexy, one side of the body is commonly paralysed, and the disease is termed *Hemiplegia*. In some cases the lower half of the body is affected, constituting the variety called *Paraplegia*. Palsy may come on suddenly, without being preceded by apoplexy, especially in persons who are much exhausted or debilitated, or who have been much exposed to certain mineral vapours; but in general the disease approaches gradually, and is preceded either by affections of the head, and other symptoms threatening apoplexy, or by weakness, numbness, and tremors of the limbs. The loss of voluntary motion in palsy is sometimes accompanied by a loss or diminution of sensation in the parts affected, and, in some cases, the want of motion and sensation alternates. The probability of complete recovery from a paralytic stroke depends much on the age of the patient, and the nature or violence of the exciting cause by which it has been produced.—When sensation as well as motion is lost, and when the affected limbs shrink, the case is in general hopeless. Palsy may take place in persons of very different habits, but chiefly in those who are predisposed to apoplexy, or those who are greatly debilitated It may be excited by all the causes that produce apoplexy, or by exhaustion, fatigue, sudden and violent depressing passions, and exposure to vapours of lead, quicksilver, or arsenic. Paraplegia is usually owing to an injury, or diseased state of the spinal cord, producing compression on the origin of the nerves that supply the lower half of the body. The treatment of palsy must vary with the age and habit of the patient and the nature of the exciting cause. In plethoric persons, and especially after apoplexy, bleeding is commonly requisite, and purgatives and low diet are always proper. In palsy, connected with debility, bleeding and low diet would do harm; and various stimuli, both internal and external, are required, with the occasional use of purgatives to keep the bowels open. The choice of internal stimuli must be left to the practitioner. The external remedies most likely to prove efficacious are, friction, phosphorated oil, oil of turpentine, whipping with nettles, electricity and galvanism, and, in cases of debility, the warm bath. Blisters or issues will often prove useful, especially in paraplegia, and the patient should be encouraged to make frequent attempts to move the paralytic limbs.

In *Syncope* the patient suddenly loses sensation and the power of voluntary motion, without convulsion or stertorous breathing; the pulse stops, and the face is pale. The fainting fit sometimes takes place without any warning; but more commonly it is preceded by giddiness, sickness, dimness of vision, singing in the ears, and sinking at the breast or back. The fainting often returns periodically, and may recur every day, or several times in a day. In general, if the patient be in a horizontal posture, he soon recovers; but in a few cases the disease proves fatal at once, or returns so often and so speedily as to produce a permanent cessation of the heart's motion. Except in this last case of repeated and frequent faintings, the prognosis is usually favourable. Debility is the chief predisposing cause, but the exciting causes are various, as profuse evacuations, sudden and violent depressing passions, extreme heat, intense cold, long standing erect, exhaustion from fasting or fatigue, powerful odours, indigestible food in the stomach, and certain antipathies. The treatment is the direct opposite to that of apoplexy. In the fits the patient should be placed horizontally, exposed to a current of free air, while the face is sprinkled with cold water, the temples rubbed with hartshorn or ether, and the same or other strong volatile substances should be held to the nostrils. When the power of swallowing returns, a little warm brandy and water, or a mixture of water with tincture of lavender and compound spirit of ammonia, should be given in small quantities. A relapse is best prevented by avoiding the exciting causes, and strengthening the nervous system. When the disease returns periodically, the patient should lie down, and take a gentle stimulus, such as those already mentioned, or a glass of camphorated mixture, a short time before the expected paroxysm.

*Dyspepsia*, or indigestion, is one of those Proteus-like diseases, of which it is not easy to give a general description, as it exhibits a great variety of symptoms in different persons, and even in the same individual at different times. It is usually marked by flatulence, heart-burn, eructation, or sometimes water-brash, sickness, and sometimes vomiting, pain or uneasiness at the pit of the stomach, headach or giddiness, and a costive or irregular state of the bowels. The appetite is sometimes defective, at others inordinate or depraved. The skin is generally dry, the face pale or sallow, and the tongue more or less furred. The spirits are variable, the muscular powers weak, and the sleep deficient or disturbed. The complaint sometimes disappears spontaneously as life advances, but if it remain it usually terminates in asthenia, or leads to dropsy. Persons of sedentary habits or employments, and such as are addicted to the pleasures of the table, or the immoderate use of tea or tobacco, are most subject to it; and it may be brought on or increased by occasional excess in any of these indulgences, by taking food that is unwholesome or difficult of digestion, long costiveness, and sudden emotions of the mind. During an attack of dyspepsia the principal object is to relieve urgent symptoms; flatulence by aromatics, as cinnamon-water or ginger; heartburn by antacids, especially calcined magnesia, crystalized carbonate of potash, and soda water; eructation and nausea, if the stomach be loaded, by an emetic; vomiting, if violent, by brandy or laudanum; headach and costiveness by warm purgatives, as aloetic powder, compound rhubarb pills, or pills of aloes and myrrh; pain in the stomach, when not occasioned by repletion or undigested food, by opium and calomel; want of appetite, by bitters. In the meantime the diet should be light and digestible, rather of animal than vegetable food, but rendered moderately stimulating by condiments, with as little liquid as possible, and that chiefly weak brandy and water. When the principal symptoms are relieved, a short course of tonic medicines, such as Colomba, quassia, gentian, or iron combined with myrrh, with occasional laxatives, free air, regular exercise, carried, if convenient, the length of exciting perspiration, and abstinence from fermented liquors, tea, and snuff, will, in general, complete the cure. The great preventatives of dyspepsia are temperance, exercise, flannel clothing, regulation of the bowels, and equanimity of temper.

What has been called *Hypochondriasis*, spleen, or vapours, is a disease nearly allied both to dyspepsia and to hysteria. It is distinguished by symptoms of indigestion, accompanied with great despondency of mind, amounting almost to melancholy. It is most common in males of the melancholic temperament, and is sometimes very obstinate. The treatment is much the same as that of dyspepsia, combined with change of air and scene, the cold bath, and the means recommended for the cure of melancholy in Chap. VII.

The terms *Asthenia* and *chronic weakness* have been applied to distinguish a complication of nervous symptoms very common among the inhabitants of cities and large towns, especially the votaries of fashionable dissipation, and those who are condemned to pass the greater part of their time in the confined apartments and monotonous occupations of extensive manufactories. The principal symptoms are langour, lassitude, muscular weakness, and aversion to labour or exercise, tremors, confusion of head, drowsiness in the day, disturbed sleep, variable spirits, feeble and vacillating mind, irritable temper, impaired digestion, with frequent desire for food, feeble pulse, very quick in some cases and unusually slow in others, anxiety and shortness of breath on slight exertions, and a costive or variable state of the bowels. The complaint is generally worst in summer. Persons in this situation, who are of the sanguine temperament, are very liable to spasmodic diseases; and those of the phlegmatic and melancholic temperaments readily fall into dropsy. The treatment recommended for dyspepsia and hypocondriasis is well suited to asthenia; but no permanent benefit can be expected from diet or medicine without pure air, regular exercise, and a change of occupation or mode of living.

## CHAP. X. OF CACHECTIC DISEASES.

Under this term are here included several important and dangerous diseases, which agree in nothing but in shewing a depraved habit of body, or of some particular system, namely, Diabetes, Scrofula, Rickets, Consumption, Dropsy, and Jaundice.

In *Diabetes* the flow of urine is greatly increased the quantity voided exceeds that of the liquids drunk, and its quality is so much changed that it has a sweet odour, and when evaporated affords scarcely any salt, but a large portion of saccharine matter: The appetite is inordinate, the thirst great, the skin dry, the body emaciated, and there is great muscular weakness. This is an insidious and a dangerous complaint, not easily discovered at its commencement, and probably incurable when it has taken possession of the constitution. It is now considered a primary disease of the digestive organs rather than of the kidneys. Its causes are obscure, and its treatment not yet understood. The symptoms are relieved by bleeding, animal diet, opium, astringents, and the warm bath.

*Scrofula*, or Evil, is a constitutional disease, shewing itself chiefly in early life, by various external or internal affections, especially swelling, inflammation, and ulceration of the glands of the neck, distortion and ulceration of the spine, swelling of the joints, commonly called white swellings, and, in young children, by a swollen belly and enlargement and obstruction of the mesenteric glands. The disease sometimes subsides spontaneously after the age of puberty, but more commonly it ends in atrophy and hectic, or lays the foundation of consumption. Persons of the sanguine temperament, with clear smooth skin, light hair, and blue eyes, and descended from scrofulous parents, are the ordinary victims of this disease; and, in them, the obvious symptoms are excited by various causes, such as impure air, improper diet, want of cleanliness, sedentary habits, and external injuries. The prognosis is unfavourable in proportion to the inveteracy of the scrofulous habit, and the treatment is uncertain. Children of the appearance and habit above described should be brought up in such a manner as to invigorate the system, should be accustomed to free, pure, and dry air, regular exercise, daily friction over the body, more especially the belly and the spine, the regular use of the cold bath, and rather a generous diet, while strict attention should be paid to the state of the bowels. Various remedies have been recommended for the cure of scrofula when it makes its appearance, as tonics, muriate of lime, muriate of baryta, calomel combined with purgatives, sea-bathing, blisters, and issues. The choice of these remedies, and indeed the whole treatment, must be left to a skilful practitioner.

*Rickets* is a disease of children, marked particularly by softness, enlargement, and distortion of the bones, especially those of the spine, chest, head, and pelvis, and the joints of the ancles and wrists. To the affection of the bones are added various symptoms of general debility, as langour, listlessness, pale and distressed countenance, flabbiness of the muscles, irregular appetite, costive or disordered bowels, and protuberant belly. These symptoms generally precede the obvious change in the bony system; and whenever they appear in delicate children, the back, breast, and joints should be daily examined with care, as the only chance of preventing the progress of the disease consists in the timely application of the proper remedies. The disease, when not early attended to, either terminates in hectic, or produces permanent deformity; but if the tendency to these events can be kept in check till after puberty, the patient is generally safe. For that purpose, free and pure air, regular but moderate exercise, alternated with the horizontal posture on an easy but not soft couch, friction, a diet more of animal than vegetable food, avoiding acids, keeping the bowels regular, sea bathing, with the occasional use of tonics, and perhaps phosphate of lime (burned hartshorn) boiled in milk, afford the most likely means of overcoming the depraved habit, and fortifying the constitution.

*Phthisis*, or *consumption*, that terrible scourge of the British islands, by which it is computed that nearly 60,000 of their inhabitants are annually consigned to an untimely grave, usually begins to shew itself about the age of puberty by symptoms of catarrh, with pain of one side, and occasional spitting of blood. Those symptoms generally disappear on the approach of summer, to return the following winter with increased violence. The breathing becomes difficult, and is hurried by slight exertions or mental agitation; and the cough, which was at first dry, or attended with only mucous expectoration, assumes its true form, becomes habitual, and is accompanied with purulent expectoration. To these affections are added hectic fever, with a very quick and feeble pulse, and great muscular weakness, while the mind usually retains its former vigour, or exhibits marks of superior activity and cheerfulness, and the patient's hopes of recovering appear to strengthen in proportion as the approaching fatal termination of the disease is more evident to others. As the disease advances the weakness increases, and the threefold evacuation by the lungs, the skin, and the bowels, the two latter of which have already been mentioned as characteristic of hectic, gradually exhausts the powers of life, and at length puts a period at once to hope and to existence. Consumptive persons usually die before their twenty-fifth year, and few attain the age of thirty. The prognosis is unfavourable, and the only chance of escape lies in arresting the disease at its first appearance. The distinction of phthisis, when confirmed, is easy; and even at its commencement, on considering the circumstances to be immediately noticed, it is not difficult to foresee, that what appears to be a common cold may prove to be the commencement of consumption. The disease is intimately connected with scrofula; and persons of scrofulous constitution, or descended from scrofulous or phthisical parents, are its chief, if not only victims. The treatment is partly preventative, partly palliative. The former consists in avoiding the principal exciting causes, cold and moisture, by flannel and other warm clothing, and nourishing but not stimulating diet, and by invigorating the general system by the means already so often pointed out. A due regulation of temperature is of the utmost consequence; and that is best obtained by removal to a warmer and more settled climate, or, where this is unattainable, by confinement to a suite of communicating apartments, sufficiently spacious, and kept at the required temperature, between 60° and 65°, by artificial heat. If pain of the side come on, it is to be relieved by a moderate bleeding, or by blisters; and spitting of blood must be treated as recommended under hemorrhages. The symptoms of confirmed phthisis are palliated by demulcents, opium, or henbane, and ipecacuanha to relieve the cough; the use of sulphuric acid, with a few drops of laudanum, to check perspiration; opium and mild astringents to counteract purging; nourishing food and decoction of Iceland moss to check debility; with the cautious use of foxglove, in the form of tincture, to moderate the circulation. This is all that can properly be said respecting the domestic treatment of consumptive patients; and it is obvious that the superintendence of a medical practitioner is required in so terrible a malady.

*Dropsy* is a general name for those diseases in which an accumulation of serous fluid takes place in some part of the body; and it is distinguished by particular names, according to the seat of the accumulation. Thus, dropsy of the cellular membrane is termed *Anasarca*, which is most common in the lower extremities, and is known by a pit or depression remaining for some time after pressing the part with the finger. Dropsy of the brain is called *Hydrocephalus* or *Chronic hydrocephalus*, to distinguish it from the acute disease described under inflammations. This variety takes place in weakly children, and is marked by a great enlargement of the head, with a pale and heavy countenance, and great general debility. *Hydrothorax*, or water in the chest, is not always easily distinguished, but may, in general, be suspected when there is difficulty of breathing, increased in the horizontal posture, with dry cough and disturbed sleep; and is rendered certain, when, on striking one side of the chest with one hand, while the palm of the other presses the opposite side, a fluctuation is perceived. Dropsy of the belly, or *Ascites*, is easily known by the protuberance of the belly, with marks of fluctuation. In most of these varieties of dropsy the urine is scanty and high-coloured, and deposits a copious sediment, and in some cases the clear part coagulates when heated. The pulse is feeble and generally frequent, the face pale, the muscles flabby or emaciated, and the skin dry and cold. Of the several varieties, anasarca is the most common, and is generally observed in combination with the others, especially with ascites. The prognosis of dropsy is generally unfavourable, except in simple anasarca, where the urine is little diminished in quantity, and does not coagulate by heat; for though cases of perfect recovery sometimes occur, and though the accumulation of fluid may disappear for a time, it but too often returns, and at last baffles all the powers of medicine. The probability of success is diminished in proportion to the age of the patient and the extent and obstinacy of the exciting cause. All the varieties of dropsy, except hydrocephalus, are most likely to occur in persons of the phlegmatic and melancholic temperament who are past the middle age, and have been addicted to the intemperate use of spiritous liquors, or in those who have been debilitated by violent acute disease, or exhausted by famine and fatigue. The exciting causes are various, and often obscure; but the most common are exposure to cold and moisture, and a schirrous state of some organ, especially the liver, spleen, or stomach. The complaint evidently depends on a want of balance between the action of the exhalants, which furnish the serous fluid that bedews the principal cavities, and that of the absorbents, by which, in health, any accumulation of that fluid is prevented. In the treatment of dropsy many niceties, of which the practitioner alone can judge, are required. The principal objects to be kept in view are to disperse or evacuate the effused fluid, and to prevent its subsequent accumulation. To effect the first object we employ purgatives, especially such as produce watery evacuations, as the sulphates of soda and magnesia, gamboge, bitter apple, and crystals of tartar; by diuretics, as squill in powder or tincture, foxglove in infusion or in tincture, with spirit of nitrous ether, gin punch, or crystallized carbonate of potash, by friction in anasarca, and by mercury both internally and by friction in ascites, and when organic disease is suspected. When the accumulation increases in spite of such remedies, it is usually evacuated by puncturing in anasarca, and tapping in ascites. The second object is attempted by strengthening the general system by air, exercise, generous diet, warm sea-water bathing, and tonic medicines, especially the bitters, in combination with crystallized carbonate of potash, and iron in conjunction with myrrh.

*Jaundice*, when confirmed, is distinguished by the following symptoms: yellowness of the front of the eyeball, yellowness and itching of the skin, dark-coloured urine, tinging linen immersed in it of a yellow colour, scanty evacuations from the bowels, of the colour and consistence of white clay, want of appetite, sickness, and other disorders of the stomach, with occasional pain in the right side, or at the pit of the stomach, and a bitter taste in the mouth. The pain, sickness, and costiveness are usually the earliest symptoms, and are followed by the affections of the skin and the changes on the excretions. If these symptoms continue for any considerable time, chronic weakness or hectic comes on, and gradually destroys the patient, or the disease may excite a dangerous inflammation of the liver; but, in general, it either goes off spontaneously or yields to medical treatment in a few days; so that, except in very aggravated or protracted cases, the prognosis is favourable. The disease depends on a retention or deficient secretion of the bile, and is commonly brought on by obstruction of the biliary ducts by concretions in the gall-bladder. It is best removed by bleeding when the pain is violent, emetics, purgatives containing calomel, fomentations to the right side, the warm bath, opium occasionally, and the sulphureous mineral waters of Harrowgate, or similar springs, followed by the usual means of renovating the health and strength.

## CHAP. XI. OF LOCAL DISEASES.

Of the numerous diseases denominated *local*, most, including the chronic affections of the skin, belong rather to SURGERY than medicine, and will be considered under the former title. The only local complaints which can properly be noticed here are *gravel* and *worms*.

Only that slight degree of *Calculus*, commonly cal-ed *gravel*, is usually the subject of medical treatment. It is marked by pain in the loins, the *urethra*, or the intermediate passages, with difficulty in passing and often in retaining the urine, and the occasional discharge of sandy or small stony matters, which are found, commonly in the form of sediment, in the urine. In most cases, symptoms of indigestion also occur. Elderly and gouty persons are most subject to gravel; but it may take place at almost any age. It is occasioned by the formation of calculous concretions in the kidney or bladder, and seems to depend much on a vitiated state of the digestive organs. It is often relieved by mild diuretics, as spirit of nitrous ether, with small doses of oil of turpentine, accompanied with the plentiful use of mucilaginous liquors, by saline purgatives alternated with opium, and by the warm bath. At the same time, the stomach and bowels are to be strengthened by light nourishing food, and afterwards by tonics; and to prevent the complaint from increasing, such remedies are to be employed as counteract acidity or alcalescence in the alimentary canal, according as the one or the other is found to prevail in the urine or its sediment; namely, magnesia, crystallized carbonate of potash, or soda combined with soap, in the former, and diluted muriatic acid in the latter case. The treatment of *stone* must be referred to SURGERY.

*Worms.*—Referring to the treatise on HELMINTHOLOGY, for an account of the several species of worms which most commonly infest the human alimentary canal, we are here to consider the complaints which they occasion, and the most successful methods of treatment. The symptoms which are usually supposed to indicate the presence of worms are often very obscure and uncertain, especially in children, and it is sometimes only by the actual appearance of the worms that the true nature of the complaint is ascertained. But, in general, a tumid belly, offensive breath, picking of the nose, grinding of the teeth, disturbed sleep, variable appetite, and a deranged state of the bowels, pale complexion, emaciation, and feeble pulse, lead to the supposition that *lumbrici*, or the long round worms, are lodged in the alimentary canal. Itching and heat at the fundament, with slimy stools, in which are occasionally seen white filaments, sometimes moving briskly, shew the presence of *ascarides* or thread worms; and a gnawing sensation about the pit of the stomach, relieved by eating, variable and sometimes voracious appetite, with occasional sickness, giddiness, gripes, and convulsive affections are supposed to indicate the *tape-worm*. This last parasite occasions the most distressing complaints; but the round worm is considered the most dangerous, as it sometimes produces death, by perforating the stomach or obstructing the bowels. The proper remedies for the disease produced by this species are small dozes of rhubarb, with a drop of oil of rue every night, with cowhage, sea salt, worm seed, or powdered chamomile flowers every morning for some time, and now and then a brisk purgative of senna, or jalap and calomel, with a little scammony, taken early in the morning, and nourishing diet, consisting more of animal than vegetable food. Ascarides are frequently removed by rhubarb at night, some bitter tonic in the morning, with now and then a brisk purgative of aloes and calomel in the form of powder, and the daily use of clysters of lime-water, given luke-warm. In both these cases, along with nourishing diet, the use of steel carvies, or rust of iron, tends to strengthen the stomach and bowels, and thus assist the expulsion of the worms. Oil of turpentine, and electricity in slight shocks, along the course of the alimentary canal, followed by purgatives, are the best antidotes to the tape-worm.

## CHAP. XII. OF ACCIDENTAL DISEASES.

Of the diseases produced by accidents, many are of a local nature, and belong to the department of SURGERY, as burns and scalds, sprains, contusions, laxations, fractures, and wounds. Others are more general, and come within the province of MEDICINE, as *Asphyxia*, *Narcotismus*, and the affections excited by the mineral poisons.

*Asphyxia*, or apparent death from suspended respiration, differs in its symptoms, and a little in its treatment, according to its exciting cause, or the manner in which it has been brought on. It is commonly the consequence of drowning, hanging, or exposure to noxious vapours. In all these cases, expiration has, for a time, literally taken place, the pulse is imperceptible, and blood has generally accumulated in the vessels of the brain; but, in the first case, the face is pale and the whole body cold; and, in the second, the body for some time after the accident, is warm, and the face swollen, and generally flushed or livid; while, in the third, the heat is often greater than natural, and the joints flexible for some time after the accident. The noxious vapours which generally produce asphyxia are chiefly carbonic acid gas or fixed air, generated in empty wells, cellars, and similar situations, or produced during the fermenting processes of brewing and distilling; hydrogen gas, or inflammable air, evolved in mines; and compounds of this latter gas, with carbon or sulphur, generated by the burning of inflammable substances in close apartments.

The methods to be adopted for recovering drowned persons consist in stripping the body, if not already naked, drying it quickly, wrapping it up in warm blankets, or the spare clothes of the byestanders; removing it on a board or proper carriage, with the head supported so that it shall neither fall back nor sink upon the breast, as expeditiously as possible to the nearest convenient house; restoring the natural heat by means of warm blankets, fomentations, or what is best, the warm bath, and at the same time inflating the lungs, by means of bellows, the tube of which is inserted into one nostril, or with the proper apparatus into both, while the mouth, and, in the first case, the other nostril are closed, and the upper part of the wind-pipe drawn a little down, and pressed back against the gullet to prevent the air getting into the stomach. When the chest appears to be inflated, the nostrils and mouth are to be unclosed, and pressure made on the chest to expel the air, and thus by alternate inflation and expulsion the natural process of breathing is imitated, and, if death have not taken place, the action of the lungs and heart will probably be restored, provided the means are persisted in for a sufficient length of time, not less than six hours. To these principal means of restoring animation, external warmth and inflating the lungs must sometimes be added, stimulating the skin of the breast and stomach by rubbing it with ammoniated oil; stimulating the bowels by a large clyster of warm water, with two or three tea spoons full of hartshorn; stimulating the stomach as soon as sensation appears to be returning, by injecting into it, through a flexible tube, a few ounces of warm negus, or warm water with a little hartshorn; applying volatile substances to the nostrils, by means of a feather, when signs of life return; cupping the back of the neck if the face appears swollen or discoloured, or if there be reason to think that the patient was intoxicated at the time of the accident; and the application of galvanism by slight shocks passed through the chest, if the other means of resuscitation prove ineffectual during the first hour. In these attempts, it is of consequence that the room in which the body is placed, should be warm but not close, and that all persons should be excluded except those who are likely to be useful, to the number of about six, who should be divided into two parties, one for keeping up artificial heat, and employing stimulating friction, and the other for carrying on the process of artificial respiration. To prevent fatigue, where the attempts are long continued, another set of intelligent persons to relieve the first should be ready in an adjoining room.

Recovery from *hanging* must be attempted as soon as the body is cut down, and while it is warm, by bleeding in the jugular vein, or cupping the back of the neck, inflating the lungs, stimulating the stomach, bowels, and nostrils, and galvanic shocks through the chest. Gentle agitation, as in a light cart, while the head is supported, has, in this case, been followed by resuscitation.

In *suffocation* from noxious vapours, the body, if warm, must be freely exposed to the open air, and cold water must be dashed over it, while placed upon a door or board in an inclined position, with the head and breast highest; and if the veins of the neck be turgid, some blood should be drawn from them by the lancet or by cupping. Then the lungs are to be inflated, and the other means mentioned under drowning should be employed. If the heat of the body be less than natural, the application of artificial heat will be necessary.

By *Narcotismus* is meant that tendency to apoplexy produced by the narcotic poisons, as alcohol and opium; and under the same head may be noticed *torpor*, or apparent death, from cold.

*Dead drunk* is the epithet vulgarly, but expressively, applied to those persons who have fallen into a state of insensibility from excessive drinking. This state so nearly resembles an apoplectic fit, from congestion of blood in the head, as scarcely to be distinguished from it, except by the smell of liquor about the patient, and a knowledge of the exciting cause. But this distinction is of consequence, for though such a degree of intoxication often proves fatal when the patient is abandoned or not observed, a fatal termination may, in general, be averted by the adoption of proper means. These consist in stripping the person, or at least loosening all tight clothes, placing him in a half-sitting posture, with the head properly supported, as directed under drowning; bathing the head, neck, and breast repeatedly with cold water; and if the face be much flushed, or the vessels turgid, bleeding in the jugular vein or cupping; administering an emetic of two or three grains of emetic tartar dissolved in warm water, which, if the power of swallowing be lost, must be injected through a flexible tube, or given a large clyster of warm water with two table spoons-full of common salt; and if the hands or feet be cold, applying to them heated flannels, or bricks, or bottles filled with warm water. If by these means sensibility be restored, strong coffee should be given, and the patient should be compelled to walk about, or, if not able to exert himself, should be dragged about the room to prevent sleep and promote general circulation; and when sufficiently restored to be put to bed, he should be carefully watched as long as any apoplectic symptoms remain.

Narcotismus from opium usually begins with great excitement, if the quantity of opium or laudanum swallowed be not very great, followed by stupor and other marks of approaching apoplexy. The nature of the case may in general be ascertained by the smell of opium from the mouth of the patient, or from the matter which is usually in such cases thrown up by vomiting. The first object is to remove the poison from the stomach by a strong emetic of 25 or 30 grains of sulphate of zinc (white vitriol) dissolved in a small quantity of warm water, promoting its effect by repeated draughts of warm tea without milk or sugar; after which vinegar and water, or lemon-juice, should be given in alternation with strong coffee, while the patient is continually moved about, to prevent the soporific effects of the narcotic. When the principal symptoms are removed, wine negus with spices should be gradually given, and the patient may be suffered to sleep under careful watch. The cure is completed by purgatives.

In *torpor from cold*, besides the total suspension of sensation and motion, and the almost total cessation of circulation and respiration, the heat of the body is so much reduced, that great caution is required in the application of the usual stimuli. The body should first be, for a few minutes, rubbed with snow or nearly ice-cold water, and then placed in a bath, the heat of which is very gradually increased from about 35° to 100°. In the meantime the lungs are to be inflated, and the other means recommended under drowning, except bleeding, must be assiduously employed.

The mineral substances which are usually taken either by accident or design as poisons, are chiefly corrosive sublimate, white mercury, arsenic, copper, lead, sulphuric acid, or oil of vitriol, nitric acid, or aquafortis, and nitre, or saltpetre.

*Corrosive sublimate*, in a few grains, produces violent pain and heat in the throat and stomach, with thirst, vomiting, salivation, tremors, palsy, convulsions, and death. The nature of the poison may be ascertained by dipping into the matter vomited a plate of polished copper, which will speedily be covered with a white crust of quicksilver. The best antidote is raw white of egg diluted with warm water, and drunk copiously and repeatedly, while the breast and belly are fomented with hot water, with the other means for checking inflammation of the stomach. See Chap. II.

*White arsenic* is a still more virulent poison, producing a rough taste in the mouth, straitness of the throat, a feeling as if the teeth were on edge, great heat and pain in the throat and the stomach, spitting, sickness, vomiting of brown or bloody matter, with great anxiety and intolerable thirst, small, frequent, or intermitting pulse, fainting, alternate chills and heats, black evacuations, and death. In this case no time is left for examination by chemical tests; but the symptoms can scarcely be mistaken, and should lead to the adoption of prompt and active treatment. The only chance of recovery lies in promoting the evacuation of the poison by vomiting; for which purpose large quantities of warm mucilaginous liquors, mixed with white of egg, should be given, and sulphuret of potash (liver of sulphur) in solution should be added, though that antidote can act on the poison only when dissolved.

*Copper*, in the state of verdegris, is a very common domestic poison, occasioned by boiling food, and especially acid and fat substances, in copper vessels, and using copper measures. A metallic taste and dryness in the mouth, straitness of the throat, spitting, sickness, pain or cramp in the stomach, and retching or vomiting, are the usual early symptoms; and if they are neglected they are soon followed by purging, with bloody or dark-coloured evacuations, headach, giddiness, cramps, and the other consequences of the mineral poisons before-mentioned. Sugar dissolved in gruel is the best antidote, and should be followed by castor oil, fomentations and clysters of gruel, with sugar, if the poison appear to have reached the bowels.

*Lead* is another domestic poison, apt to be received through the medium of white wine, cyder, perry, and even water kept long in leaden cisterns. It shews its deleterious effects by cramp in the stomach and bowels, with drawing in of the belly, obstinate costiveness, sickness, tremors, and palsy of the arms, followed by tremors and shrinking of the muscles. If the poison has been recently taken, a solution of Glauber's or Epsom salts should be given, otherwise opium and calomel, with fomentations, to relieve the spasm, and afterwards castor oil to open the bowels.

When sulphuric acid, in its concentrated state, has been swallowed, it quickly produces inflammation of the gullet and stomach, followed by death. The only chance of saving the patient is immediately to give calcined magnesia diffused in lukewarm water, or a solution of white soap, in large and repeated doses. After which the inflammation is to be counteracted by the usual means.

The effects of nitric acid are still more violent and speedy, and call for a more prompt application of the same remedies.

*Nitre* is sometimes taken by mistake for Glauber's salt, as oxalic acid is for Epsom salt. The effects are similar to those already described, but milder. Vomiting and dilution are the chief remedies in the case of nitre; and calcined magnesia and castor oil in that of oxalic acid, which, though not a mineral substance, is here introduced from the frequent accidents that have lately occurred from its use.

## THE HISTORY OF MEDICINE.

The *History* of Medicine may be traced back to a very early period. Both surgery and midwifery were practised as distinct professions among the Egyptians in the time of the patriarch Joseph; and, some time after, the practice of physic, though fettered by absurd customs, and degraded by mystery and superstition, was distinguished as a separate art. It was the custom of ancient Egypt to engrave, on the pillars and walls of their temples, whatever inventions or discoveries were made in the useful arts or sciences; and those writings, dedicated or ascribed to the god *Thoth* or Hermes, and usually called by his name, were held in such veneration, that to alter them was sacrilege, and to act in opposition to their rules was a capital offence. They regulated the practice of medicine, and if a patient died, his medical attendant was acquitted of all blame, provided he could prove that he had followed implicitly the prescriptions of Hermes.

Among the Jews, medicine appears to have been little understood; the practice of it was extremely simple, and confined chiefly to the priesthood.—Frictions with oil, poultices of figs, the application of wine and oil to wounds and bruises, and the balm of Gilead, constituted their principal remedies, and they were better skilled in the prevention than in the cure of disease. The Mosaic dispensation enjoined an abstinence from pork, hare, and the flesh of all other quadrupeds which did not both ruminate and possess cloven hoofs, and from the blood and entrails of animals,—frequent ablutions, occasional fasts, and the separation of leprous and other infectious persons from the rest of the community.

Medicine first attained to the rank of a rational art under the sages of ancient Greece, where its invention was attributed to Apollo, and its improvement to Æsculapius. About 900 years before Christ, as appears from the writings of Homer, the Grecian armies were accompanied by surgeons, who administered to the relief of the wounded, and physicians seem also to have attended on the principal chiefs, though it is probable that the medical men of that time practised surgery as well as physic. Medicine was taught in the schools of philosophy so early as the time of Pythagoras, and some of his pupils, especially Alcmeon and Democritus, were celebrated for their knowledge of the animal economy.

About 400 B. C. the great Hippocrates, who has been justly styled the father of physic, began to shine conspicuous among his countrymen as a medical practitioner. His voluminous writings shew that he had an extensive knowledge of diseases, especially of those called *Epidemic;* great skill and penetration in distinguishing their nature, investigating their causes, and prognosticating their event; and much judgment in pointing out the proper means of preventing or relieving them. It is indeed true, that, in his theory of physic, he attributed most diseases to some vitiation of the fluids, especially the blood and the bile,—ascribed too much influence to the *power* of *nature* in the cure of disease, and seemed to consider the physician as little more than the observer of that influence, and the assistant of those powers; but his aphorisms or short maxims respecting diseases, his rules for the preservation of health, his cases of epidemics, and his observations on prognostics, are still admired, and read with advantage. Many of his terms, as *epidemic*, *endemic*, and *sporadic*,—his doctrine of critical days, his method of judging of the state of a patient by his general appearance, his pulse, discharges, &c.—and some of his remedies, as bleeding, purging, the warm bath, and fomentations, are still retained and employed, though not always in the cases to which he applied them.

The doctrines and practice of Hippocrates were followed with little variation, except by Praxagoras, who was a bold practitioner, and made great use of *emetics*, even in cases where they are now considered improper, till the second century B. C. when Erasistratus, a pupil of the Alexandrian school, practised physic at the court of the Syrian monarchs Antiochus and Seleucus. He was a great anatomist, and maintained that bleeding was improper as a remedy for disease. His chief remedies were emetics, clysters, fomentations, and the herb *succory*, with abstinence and exercise. About that time, or soon after, medical practitioners were divided into two sects; *Dogmatists*, who contended that it was necessary to investigate the causes of disease before attempting to cure it, and *Empirics*, who maintained that only the symptoms and the evident causes required to be known, and that the chief attention was to be directed to the former. The leader of the empirics was Serapion of the Alexandrian school, and with him may be said to terminate the Grecian period of medicine; for though such of the succeeding ancient physicians as wrote on the subject employed the Greek language, they generally practised at Rome and in its vicinity.

Asclepiades, who flourished in the first century B. C. was an Epicurean in his philosophy, and a dogmatist in his practice. He was an avowed opponent of Hippocrates, and attributed almost all diseases to the deranged state of the particles of the animal fluids, or of the tubes or pores through which they pass. His principal remedies were abstinence, gestation, friction, errhines, and sinapisms at the commencement of the disease, and wine and full diet afterwards. Themison, a disciple of Asclepiades, who practised medicine about the end of the reign of Augustus, was particularly attentive in marking the distinction between *acute* and *chronic* diseases, and the different treatment which each requires. He was the founder of what is called the *methodic* sect in medicine, and was followed in the reign of Nero by Thessalus, who is represented as an arrogant quack. Nearly contemporary with Themison, or a little after him, flourished Celsus, who, though it be uncertain whether or not he practised medicine, has left us a work on the healing art which is scarcely excelled by the writings of Hippocrates. Indeed, in many instances, he has either translated, or commented on the works of that great man, while, in others, he boldly opposes him, and adopts the opinions and practice of Asclepiades. He has detailed the practice both of physic and surgery, of his time, in his elegant work, "De Re Medica."

The most eminent physician of the Roman period was Galen, who flourished in the second century of the Christian era, and in the reigns of Trajan, Marcus Antoninus, and Marcus Aurelius. He was a professed admirer of Hippocrates, and commented largely on his writings; but he was not an abject follower of either his opinions or his practice. He attributed diseases to the excess, disposition, or combination of the Platonic qualities, hot, cold, dry, and moist, to the prevalence of one of the four temperaments, sanguineous, phlegmatic, bilious, or melancholic, or to the superabundance of the fluids, blood, phlegm, yellow bile, or black bile, on which those temperaments depend. In his practice he was chiefly a dogmatist, and attended minutely to the symptoms and causes of the disease. His remedies were drawn almost solely from the animal and vegetable kingdoms; and such medicines received, after him, the name of Galenicals. He made great use of antidotes, and also employed exercise, friction, bathing, and blood-letting. Like his predecessors, he practised surgery as well as physic, and was particularly celebrated for the cure of intermittent fevers. In his time, the practioners of the healing art were divided into numerous sects; but his writings contributed to diminish their number or strength, and continued to influence the theory and practice of medicine for many ages after his death.

The other principal physicians of the Roman period were Oribasius, who appears to have flourished some time in the fourth century; Aetius, about a hundred years after; Alexander, nearly contemporary with Aetius and Paulus Aegineta, who probably practised in the seventh century. These were all more or less followers of Galen, though they were not servile imitators of that great man, and Alexander especially displays much originality. But they are all excelled by Arctæus the Cappadocian, who, though the exact time in which he lived cannot be determined, belongs to the Roman period, and whose work on acute and chronic diseases is among the most valuable of the medical classics. By some writers, Arctæus is placed before the time of Galen.

With Paulus the ancient history of medicine may be said to terminate; but, before proceeding to its state in the middle ages, it is proper to notice the state of Materia Medica and Pharmacy among the ancients. In the time of Hippocrates, the compositions of medicines were very simple, and few mineral substances, chiefly copper, lead, vitriol, and alum, were employed as remedies; but before the time of Celsus, the taste for complex receipts, which so long distinguished the practice of medicine, had been carried to a considerable length, in consequence of the invention of antidotes, which were to counteract the deleterious effects of various poisons, and formed what was considered a universal medicine. The most celebrated of these antidotes is attributed to Mithridates, king of Pontus, from whom it was denominated *Mithridate*, and is particularly described by Celsus. It was afterwards modified by Andromachus, physician to the emperor Nero, and the new composition was called from him *Theriaca Andromachi*, or Andromachus's treacle. These famous antidotes were in the form of an electuary, composed of a great variety of animal and vegetable stimulants, with a little opium, and mixed with honey. Though now expunged from our dispensatories, it is not more than thirty years since they were prescribed by English physicians of some eminence. The pharmacy of Galen was founded on the same qualities which regulated his pathology and his practice, and his compositions were contrived so as to apply remedies of an opposite quality to those which appeared to him the principal causes of the disease. In his work on the composition of medicines, he treats fully on the theriaca.

During the middle ages, the knowledge and practice of medicine was confined chiefly to the Arabians, whose caliphs encouraged men of eminence in that profession to settle in their capital and practise at their court, and caused the principal writings of the Greek physicians to be translated into Syriac and Arabic. It is worthy of remark, that though the Arabians professed an implicit faith in the doctrines of their prophet, and though the doctrine of predestination enabled them to brave death in the field of battle, they held in high esteem an art whose object, as it must have appeared to them, was to arrest the arm of fate, and prolong human existence beyond its destined period. For a long time the works of the Greek masters, especially of Hippocrates, Galen, and Paulus, formed the only guides in the theory and practice of medicine, and from them abridged compilations were made for the use of the practitioner. Among others, the first manual of pharmacy, afterwards translated into Latin, under the title Antidotarium, is said to have been drawn up by Mesue, a physician of Bagdad, in the ninth century. But about the tenth century, the Arabian physicians began to shew some original genius and observation, and described diseases and methods of cure, either not known to the ancients, or imperfectly understood by them. In particular, Rhazes, who died near the end of that century, was the first who gave a distinct account of the diseases of children, and is the first who wrote distinctly on the small-pox; and Avicenna, who flourished in the beginning of the 11th century, though he shews little originality in his writings, was a very skilful and intelligent practitioner. Avenzoar and Averrhoes, both physicians of Moorish Spain, about the 12th century, are also celebrated either for their writings or their practice. The Arabians extended the use of opium and other narcotics, and introduced into the Materia Medica several chemical remedies unknown before their time.

While medicine was thus preserved, and a little improved, in the Mahomedan states of Asia, Africa, and Europe, it appears to have sunk into a most barbarous state of degradation, or to have slumbered in indolent repose, among the states of Christendom. The only seminary in which physic was taught was the college of Salernum in Italy; and almost the only work on the subject of medicine then studied was a collection of barbarous Latin rhymes, composed by the professors of that college, or what is called the *Schola Salernitana*. By degrees, however, the darkness was dispelled, and the Arabian medicine was introduced, or rather the ancient medicine in an Arabian dress, was restored, to Christian Europe, partly by the Crusaders, and partly in consequence of the intercourse between the Spanish Moors and the neighbouring states of France and Italy. But it was not till after the taking of Constantinople by the Saracens in the 15th century, that the original works of Hippocrates and Galen were again known in Europe; and the invention of printing, which speedily followed, contributed more than any preceding event to diffuse the knowledge of rational medicine.

The modern history of medicine properly commences in the 16th century, when that eccentric, but extraordinary genius, Paracelsus, in prosecuting his visionary schemes of forming a universal medicine, and his arrogant design of establishing a new system of physiology and pathology, founded on the principles of chemistry, rendered an important service to the healing art, by proving the efficacy of mercury, antimony, and other mineral and chemical remedies, in the cure of diseases which yielded to no other medicines. By the discoveries made during that century in anatomy and physiology by Vesalius, Columbus, Fabricius of Aquapendente, and others, pathology was placed on a more rational foundation, and the practice of medicine, especially of surgery, was improved. But Materia Medica and pharmacy were still in their infancy, and till the middle of the 16th century the Antidotarium, attributed to Mesue, and another ascribed to Nicolo de Salerno, constituted almost the only guides in those departments. The list of simple drugs was crowded with a farago of useless, absurd, or disgusting remedies, and the chemical compounds were distinguished by the most ridiculous and pompous names given to them by the alchemists, and many of which were retained till within these few years. The improvement of medicine was advanced by the establishment of medical colleges in several capitals of Europe, particularly at London and Paris; and from these bodies soon proceeded public and authorised dispensatories which superseded the private manuals of pharmacy.

Nothing has yet been mentioned of the state of medicine in England; and indeed the materials from which such an account may be collected are very meagre. For many ages, the profession was confined chiefly to the monks and friars, or to Jews, who derived their knowledge from the Arabians; and though the clergy of the Continent were, in the 12th and 13th centuries, forbidden to practise physic, the custom probably prevailed in England till near the 14th century. The celebrated Friar Bacon, who flourished in the 13th century, understood, if he did not practise medicine, and wrote a useful treatise on the preservation of health; and some writers have affirmed, that John of Gaddesden, who lived in the 14th century, and who is styled the first English physician, though his practice consisted, in a great measure, in the use of charms and amulets, was a monk. In the same century lived Ardern, who, though he was most distinguished as a surgeon, was no mean practitioner in physic, and successfully revived the use of lavements or clysters. He was well skilled in pharmacy, and some of his receipts were adopted by the London College of Physicians in their early Pharmacopæias. About the period now under consideration, the plague occasionally made its appearance in England, and another distemper, not less formidable, though it fortunately soon ceased to exist, is described by the writers of the time under the name of the *sweating sickness*, as occurring first in the latter end of the 15th century, and repeating its ravages seven times in the course of about seventy years. It appears to have been an ephemeral epidemic, or contagious fever, of peculiar violence, and which ran its course with unexampled celerity. In the 16th century the practice of medicine was improved in England by the privilege of licensing physicians granted to the London college. The most eminent English practitioners of that period were Linacre, Mayerne, and Caius. During the same age, our Materia Medica received many valuable additions by the introduction of American drugs. The 17th century was conspicuous throughout Europe for the acquisitions made in almost every department of medicine; and in these improvements Britain bore a distinguished part. The establishment of that important fact, the circulation of the blood, by Harvey, placed pathology in a new light; and the discovery of the absorbent system by Rudbeck, Bartholin, Asellius, and Pecquet, led to new methods of cure in several diseases, or rendered established practice more rational. The institution of medical lectures in the university of Edinburgh, at the close of the century, though, from the superior celebrity of the school of Leyden, it had at first little influence, deserves to be mentioned in this place, as having laid the foundation of a medical school, by which even that of Leyden was afterwards eclipsed. The practical writings of several eminent physicians, especially Willis, Sydenham, and Morton, gave an originality to physic which it had not possessed for many ages. The improvement of botany during the same century, and the establishment of botanic gardens, at Chelsea by Sir Hans Sloane, and at Edinburgh by Sir Robert Sibbald, contributed to advance the knowledge of Materia Medica, while the publication of Pharmacopæias by the London college, and some others on the Continent, and the establishment of the College of Physicians at Edinburgh, conferred the same benefit on pharmacy. While these real improvements were proceeding, the theory of medicine underwent a remarkable revolution, by the introduction of what has been denominated mathematical medicine. The success with which Borelli applied the principles of mechanics in explaining and illustrating muscular motion, induced Bellini to attempt reducing the rest of the animal economy under the dominion of the same science. In an age when mathematics and mechanical philosophy had become fashionable studies, the new theory was embraced with eagerness. The systems of Aristotle and Des Cartes, the hypothesis of the chemists, and even the rational philosophy of Bacon, were abandoned, and not only the theory, but the practice of medicine, was resolved into a series of theorems and problems. "Given a disease, to find the remedy," was considered a problem scarcely more difficult of solution than "to form an equilateral triangle on a given straight line." Even the doses of medicines proper for different ages were determined by algebraical formulæ.

Mathematical medicine was carried to an extravagant height in the early part of the 18th century, and was adopted and supported by many physicians of great learning or distinguished talent, especially Mead, Freind, and Robinson, in England, and Pitcairn, and Boerhaave in Holland, though indeed Boerhaave must not be considered a mere mechanical theorist, as his principles were derived from several of his predecessors, and were in some measure peculiar to himself. Towards the middle of the century, the mathematical hypotheses began to sink into neglect, and to give way to others of a very different character. They were successfully opposed by two eminent physicians of the Continent, Stahl and Hoffman; the former of whom, while he adopted the humoral pathology long before established, introduced a principle similar to the *nature* of Hippocrates, which he called *anima*, or the medical soul, to account for the phenomena of health or disease, while the latter attributed more to the living solids than to the fluids, and introduced the theory of atony and spasm. About the middle of the century, the medical school of Edinburgh was advancing fast towards celebrity. Its reputation, begun under the fostering care of the first Monro, Alston, the first Rutherford, Plummer, and Innes, all disciples of Boerhaave, whose doctrines they adopted and inculcated in their lectures, was completed under the guidance of their successors, the second Monro, Black, Cullen, the elder Gregory, and Hope. Under these eminent men, the theory of Boerhaave was exchanged for those of Stahl and Hoffman, especially the latter, which was modified, and in some measure new-modelled, by Cullen. Towards the end of the century, the eccentric but ingenious John Brown attempted to generalise and simplify the theory and practice of medicine, by introducing what, from him, has been termed the *Brunonian* system. He maintained, that all diseases were occasioned by either direct or indirect debility, the former class constituting *asthenic* diseases, or those which arise from exhaustion of the powers of life, and are to be removed by the application of powerful stimuli; the latter, *sthenic*, depending on accumulation of the vital power, and requiring evacuations, the abstraction of stimuli, or the use of such as are weak. Another attempt at generalisation was soon after made by Erasmus Darwin, who considered diseases as owing to the increase, diminution, or derangement of the four great faculties, irritation, sensation, volition, and association; but, in other respects, the system resembled that of Brown. These hypotheses have still their advocates and admirers; but that of Brown is more in estimation on the Continent and in America, while Darwin's system is confined chiefly to his own country.

Among the improvements in medicine during the 18th century, were the practice of inoculating for the small-pox, introduced from Turkey by Lady Mary Wortley Montague; the means of preserving

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the health of seamen in long voyages, adopted by Captain Cook; the methods of destroying or neutralizing noxious effluvia, and thus diminishing the influence of contagion, suggested by the new chemistry; the application of Galvanism to the cure of diseases; the improved methods of resuscitation in cases of suspended animation; the more free employment of cold in the cure of fevers, introduced by Wright and Currie; the use of nosological classification and definitions, by Sauvages, Sagar, Linné, Vogel, and Cullen; the improved state of Materia Medica, in consequence of the writings of Bergius, Murray of Gottingen, Lewis, and Cullen, and that of pharmacy, from the application of modern chemistry, and the repeated editions of the London and Edinburgh Pharmacopæias. The conclusion of the century was distinguished by Jenner's introduction of the vaccine inoculation, which, though it has not eradicated the small-pox, has wonderfully diminished its ravages, and, in a great measure, disarmed it of its terrors.

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The improvements begun in the last century, have been continued and advanced in the present, and medicine was never at a higher pitch of excellence than now. The best works on the history of medicine are those of Le Clerc, Freind, Sprengel, and Aikin, with Cabani's *Revolutions of Medical Science.*

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# MEDICINE, VETERINARY.

## INTRODUCTION.

**Veterinary Medicine**, or the *Veterinary Art*, sometimes called *Farriery*, comprehends the medical treatment of domestic animals, especially the horse, cattle, the sheep, and the dog, for the purpose of curing or relieving the diseases to which they are liable, and their domestic management so far as relates to the preservation of their health. Like human medicine, it is divided into *Principles* and *Practice*; the former including the *Anatomy* and *Physiology* of domestic animals, or an account of their structure and functions, so far as they differ from those of man; *Materia Medica*, or an account of the remedies employed in their diseases, and *Pathology*, or an account of their simple diseases, or morbid symptoms; the latter comprehending *Hygeiology*, or the means of preserving the health of those animals, and the *Practice* of Veterinary Medicine, or the methods of treating their diseases, both external and internal, with the account of the surgical operations usually performed.

To simplify and condense this treatise as much as possible, it is divided into three parts, HYGEIOLOGY, THERAPEUTICS, including *Materia Medica*, and PRACTICE, including *Pathology*. For farther information on the subject, the reader is referred to the works noticed at the end of this introduction.

The study of veterinary medicine, from books or lectures, as well as from observation and experience, is necessary for the veterinary surgeon, if he would not be considered a mere empirical farrier. It is useful to the country gentleman, the farmer, and the grazier, as it enables them to watch over the health of their horses, dogs, flocks, and herds, and may often save the life of a valuable animal, without subjecting them to the ignorance or extortion of a village horse or cow-doctor, or the presumption of a self-conceited groom or huntsman. It is useful even to the medical practitioner, by furnishing him with hints for the treatment of several diseases incident to the human frame, and which, while they present similar symptoms in the brute, are found to yield to different or more active remedies.

The student of veterinary medicine should be well acquainted with, not only the anatomical structure and economy, but the natural history of the animals whose medical treatment he is to undertake. This information he may derive from Buffon's Natural History of Quadrupeds, Pennant's *British Zoology*, Bewick's *History of Quadrupeds*, the works of Lawrence on Horses and Cattle, and Daniell's *Rural Sports*. He should, for the reason mentioned in the introduction to the preceding treatise, possess a competent knowledge of chemistry, either from attending a course of lectures on that subject, or from studying the elementary works of Thomson, Murray, or Henry. He should also be acquainted with, at least, the principles of *medicine*; as human and veterinary medicine, like human and comparative anatomy, tend to illustrate each other.

For accounts of the structure and functions of the horse, cow, sheep, and dog, see Snape's *Anatomy of the Horse;* Stubbs' Plates on the same subject; Vitet's *Medecine Veterinaire;* Monro's *Comparative Anatomy;* White's *Natural History of the Cow;* Coleman on the *Foot of the Horse;* and Delabere Blaine's *Outlines of the Venetinary Art.* On the means for preserving the health of those animals, Clark's *Treatise on the Prevention of Diseases incidental to Horses*; Lawrence's *Treatise on Cattle;* Sir George Mackenzie on the *Management of Sheep*, and Daniell's *Rural Sports.* On the remedies employed in the cure of their diseases, see chiefly Mr James White's *Veterinary Materia Medica*; and on the description and treatment of the diseases themselves, see Riding's *Veterinary Pathology*; James White's *Compendium of the Veterinary Art*; Blaine's *Outlines*; Findlater's *Survey of the Agriculture of Peebles*; and the works of Mr Lawrence, Sir George Mackenzie, and Mr Daniell, already mentioned. To these may now be added, Dr Dixon's elegant work on *Live Stock*, in 2 vols. 4to, with numerous coloured plates, just published.

## PART I. OF VETERINARY HYGEIOLOGY.

The means of preserving the health of domestic animals, respect chiefly their *food, shelter, exercise,* and *cleanliness.*

### Chap. I. Of the Diet of Domestic Animals.

To grass and hay, the natural food of horses, cattle, and sheep, civilization has added a great variety of other vegetable matters, as oats, barley, beans, and tares for horses; carrots, turnips, potatoes, bran, clover, saintfoin, rye-grass, and other artificial grasses, and cabbages, and grains from the brewery or distillery, chiefly for cows and cattle. Oats, from their great expence, are now seldom given, except to saddle and carriage horses which are hard worked, or must be kept in high condition. To such horses, a feed of from a quarter of a peck to half a peck is usually given twice or thrice a day; and as some horses, from greediness or bad teeth, are apt to swallow their corn without chewing it sufficiently, it is a good practice to bruise it slightly, or mix with it an equal proportion of finely cut wheaten straw. *Beans* are fit only for farm horses, and should always be boiled or steeped. *Carrots,* sliced, form an excellent food for all horses, especially such as are short-winded. Of the artificial grasses, lucern is the best for horses, and should be eaten green. *Hay* is generally allowed freely, but care should be taken that it be neither fermented nor musty. *Water* should be given night and morning to horses confined to the stable, in less or greater quantity, as their food is succulent or dry; and when a horse comes home heated, his water should be a little warmed. The quantity as well as quality of the food should be proportioned to the labour or exertion the horse has to undergo; but in all cases the times of feeding should be regular, and time and rest must be allowed on these occasions. When a horse is heated and fatigued with a hard day's journey, a long chace, or a contested race, a bottle of strong ale will prove a safe and good cordial.

*Cattle,* which are not to be immediately fattened for the butcher, are best fed, during the summer, in the open pasture, taking care to select grass of such a quality as is suited to the different ages and circumstances of the cattle. When bred upon the spot, those of a year old will require the richest pasture to prevent their stinting or falling off, and the next in quality should be reserved for those that are the soonest to be fattened. As purchased cattle are usually in a very poor condition, they should first be placed in pasture proportionally poor, and be gradually and successively removed to richer enclosures; as nothing tends more to produce disease, in these and other domestic animals, than a sudden change from scarcity to plenty. Free access to water, both as drink and the means of cooling and refreshing the body in hot weather, is of the greatest importance to all the three classes of herbivorous domestic animals. For winter-feeding, cattle are usually brought into the farm-yard, or placed within proper buildings, and fed on straw, hay made from grass or clover, cabbages, Swedish turnips, or potatoes. Straw, clover, hay, and turnips are sufficient for cattle that are merely to be sustained; but year-olds and fattening cattle require grass, hay, and potatoes, which last should be washed and boiled.

*Milch cows* produce most milk when fed with saintfoin in summer, and with grains and potatoes during winter.

*Calves* for veal should be fed only on new milk, but this should be given rather sparingly for the first ten days, after which it must be plentifully supplied. The Essex custom of inclosing these animals in a narrow box, so contrived as to admit air, while it excludes the light, probably contributes to their fattening; and the chalk given them to lick, corrects the acidity apt to be produced in their stomach and bowels. A moderate bleeding or two may also be necessary to check plethora, but the practice of bleeding once a week is cruel and absurd.

*Sheep* will feed well wherever the grass is short and sweet; but it is of the utmost consequence that their pasture should be dry, or at least not wet with *stagnant* water, as such marshy ground tends to produce the rot. The remarks already made respecting cattle will also apply to sheep, so far as that such as are bred on the spot must be kept on a uniform pasture, be it rich or poor; and those purchased must be put to feed in a pasture very little superior to that which their condition shews them to have last left. It is advisable to confine the sheep during the night within folds or pens, and not allow them to graze in the open pasture till the dew be off the grass. But while they are in the fold it is necessary that they be supplied with wholesome food; and for this purpose turnips, properly cleaned and freed from decayed parts, answer very well. As a sudden change from succulent to dry food, which latter is, in a great measure, unavoidable in winter, is very prejudicial to the health of sheep, they should, about the end of October, be gradually accustomed to such a change, by placing them alternately in rich and poor pasture. Hay and turnips are the winter food of sheep, where they can be afforded; but a difference must be made in the mode of distributing the latter for sheep fed for mutton, and for ewes that are with lamb. The turnips for the former may be consumed in the turnip field, just as they are dug up; but for the latter they should be cleaned and carted to a grass field or to a fold. As all stagnant water is adverse to the health of sheep, their pastures should be supplied with a running brook or burn, or, where that is not attainable, with a shallow pond with a *gravelly* bottom.

It is well known that the natural food of *dogs* consists of animal matters; but, in their domestic state, those matters must be supplied in very different proportions, according to the purposes for which the dogs are kept. Foxhounds, harriers, and greyhounds require most animal food, such as horses flesh, and the liquor in which it has been boiled, with a proportion of oatmeal. It is wrong to give dogs carrion in a very putrid state; as, besides rendering them very offensive, it disorders their bowels. Meat in a raw state should never be given to dogs; it makes them ferocious, and gives them a thirst for blood.

Dogs employed in the chace should be regularly fed twice a-day, or oftener if in poor condition; and it is proper to feed them separately or in parties, according to their condition and appetite. On hunting days they should have only a slight morning meal, and rather a good supper after their return. The best animal food for pointers and most other dogs, except those already mentioned, is bullocks' liver, not too much boiled; but mastiffs and other large house dogs and terriers, thrive well on bones. Lap-dogs, and all other pet dogs which take little exercise, should have flesh only once a-day, and that in small quantity. Oatmeal is the heartiest vegetable food for dogs. It should be coarse and old, especially for hounds, and should be well boiled. Many dogs will not take it in the form of pottage, but readily eat it when made into cakes. To no animals is a constant supply of clean water so necessary as to dogs.

## Chap. II. Of Shelter for Domestic Animals.

All domestic animals require occasional shelter, to screen them from the inclemencies of the weather, or defend them from the attacks of insects or other enemies. For this purpose, small copses or clumps of trees form the most natural protection, and should, if possible, make a part of every large pasture. Where they are wanting, their place may be supplied by hovels, sheds, cots, or folds; and, in winter, horses, cows, and cattle are provided with appropriate habitations. The remarks on this subject relate to stables, byres, sheep cots and folds, and kennels.

*Stables* should be built in a dry airy situation, at a convenient distance from the dwelling-house, so that the horses may be easily attended to in case of sickness or accident. The walls should be of brick, lathed and plastered within to keep out damp. The interior height should be in proportion to the size of the building, but should, in all cases, exceed eight feet. The smallest stable should have at least one glazed and sashed window, and large ones should have several, on the same side with the door, one or two of which should be furnished with a ventilator in one of the upper panes, or such an apparatus may be placed above the door. Where, as is usually the case, hay-lofts or granaries are built above the stables, the ceiling between them should be formed with iron instead of wooden rafters, and the floor above is best made of thin stone flags instead of planks, to lessen danger from fire. The floor of the stable should be paved with small high-burned bricks, and should have a gentle declivity from the manger backwards, terminating in a shallow gutter, with openings in the end walls to carry off water. The stable is usually divided into stalls, either by close wooden partitions, or by two bars on each side, one about two feet above the other. Close stalls are warmest, and therefore best for sick horses; but open stalls are generally preferred for fine horses; and, to prevent danger to the horse from kicking, the lower bar should be moveable. Where a stable is large, it is often made with two rows of stalls opposite each other. This is a bad practice, unless the intermediate space be so wide as to prevent injury to the horses or grooms from kicks. Indeed small single-stalled stables are always best, as too many horses should never be crowded together in the same space, and where many are kept it is of advantage to have two or more stables. The general dunghill should, on no account, be in contact with the stable.

*Byres*, cow or cattle houses, should be constructed like stables, so far as respects the outer walls, their inner covering, the height, and pavement; and, though glazed windows are generally thought unnecessary, they should be furnished with two or more openings like those of windows, closed occasionally with wooden shutters, moving on pivots in the middle, so that they may be opened during the day to admit light and air. There should also be a ventilator above the door. No ceiling is necessary in those buildings; and it is better that the roof should be angular and lofty, and either well thatched or covered with pantiles well pointed within. They are seldom divided, even by moveable bars, though this would be a good practice; and instead of racks and mangers they have usually a contrivance for feeding, by which the cows or cattle are loosely confined by the neck, so as to prevent their drawing back their heads. With gentle beasts this is unnecessary, and with vicious, though safe to the bystanders, it is dangerous to the animals themselves. It is better to fasten them with halters in the manner of horses, when they will injure neither themselves nor their attendants. Racks and mangers have also been adopted with advantage. Where many cows or cattle are kept in one byre, openings in the back wall should be made for taking out the dung and refuse. It is advisable to litter these animals at night, both for their own comfort and for the sake of the manure thus obtained. If that be thought too expensive, the place where they repose should have a platform of soft wood raised a few inches above the pavement, and perforated with holes to carry off the water. The store-house for turnips or other food may be contiguous to the byre, but the dunghill should be at some distance.

*Sheep-cots* are easily constructed where wood is plentiful, by cutting saplings in thinning plantations, or large straight branches in pruning the trees, and fastening two of them together by the small ends at an angle, so that the large extremities may be from 12 to 14 feet apart; then securing these about a foot from the top by cross spars, and, before the trees or branches are joined, strengthening them by larger spars morticed into them, and projecting about a foot on each side. They form the main parts of the structure, and are to be fixed in the ground at about ten feet distance from each other, and joined at the top by similar saplings or branches, while others are passed through the upper openings, resting on what may be called the couples, and others are fastened on the outside, resting on the projecting ends of the lower spars. Thus is formed the frame of the roof, which may be completed by twisting between the horizontal beams small twigs in the manner of wicker work, and covering them with two layers of heath by way of thatch; the back part and ends of the structure must be covered with slabs, or with wicker-work plastered with clay, and parts of the front are to be secured in the same manner, only leaving a sufficient number of openings to admit the sheep. Folds may be constructed either with hurdles or with turf; but the latter is in every respect preferable. The walls must be raised about six feet high, and be thickest at the foundation; and several openings are left, which may be closed with hurdles. The sheep should be accustomed, before the winter sets in, to enter the folds now and then, and they will afterwards readily go in of themselves on the approach of bad weather.

Single dogs, that are kept as watch-dogs, should be provided with a kennel, in proportion to their size, made of weather boarding, with an angular roof covered with tarpaulin. The bottom should be raised some inches from the ground, and perforated with several holes. Where several dogs, as greyhounds or pointers, are kept, a spare stable or small barn may be used as a kennel, by fixing along one or two of the walls a proportional row of benches, at a sufficient height above the floor to avoid damp, and allow tired dogs easily to jump upon them, but not creep under them. The benches are littered with clean dry straw, which must be shaken up every night, and renewed whenever it becomes damp or musty. The regular kennel for hounds should be situated in a dry and airy spot, within sight of the dwelling-house, and, if possible in the neighbourhood of trees and running water. It should be built of brick, lathed, plastered, and white-washed within, with a sufficient roof, two or more sashed windows opening both from above and below, two doors in front and one at the back, a paved floor highest in the middle, and gutters opening without. The building usually consists of three principal apartments communicating with each other, one at each end furnished with sleeping benches, and one in the centre with troughs for a feeding-room. Attached to the main building are also a place for keeping straw and oatmeal, an open grassed court surrounded with high paling, a pump well, and a gallows for hanging carrion.

## Chap. III. Of Exercise, Air, and Cleanliness.

A certain degree of *exercise* is necessary for preserving the health of all domestic animals, but more especially for horses and dogs. Cattle and sheep are most healthy, and their flesh is most wholesome and nourishing, when they are allowed to roam at large in the open fields; but quick motion is incompatible with their nature and habits, heats their blood, and, when employed just before they are slaughtered, injures the quality of the meat. When confined in byres or cots during winter, they should be driven out to some distance every day, for the sake of air as well as exercise, and that is in general sufficient.

Horses and dogs, being naturally active and fond of rapid motion, must be treated in a different manner. It is generally thought sufficient for saddle or carriage horses that are not regularly worked, to ride them twice a-day to a neighbouring pond to water; but this is a mistake. Such horses should be taken out for a great part of the forenoon, and made to undergo a degree of exertion not much less than that to which they are commonly or occasionally subjected. This is particularly necessary with race-horses and hunters, who are frequently called on for severe or long continued labour. Carriage horses should, on these occasions, be harnessed to a light caravan, or what is called a *breaker*, that they may not lose the accustomed sound of wheels. The exercise of horses should be entrusted only to a careful and steady groom or coachman. It should not be carried the length of fatigue, and should not be so violent as to produce sweating. On this head it is proper to observe, that when a horse returns home heated and fatigued, he should not be allowed to stand still in the open air, but should be led gently about for some minutes, to cool gradually, and, if sweating, should be wiped or *scraped*, as practised on the course, and then covered with a light cloth thrown loosely over him. Cold drink should never be given to a horse heated and fatigued, but it should be moderately warmed. Much less should he be taken to a pond, or washed with cold water; but it will be proper, as he cools in the stable, to rub him gently down with successive whisps of soft straw till he be perfectly dry.

But little requires to be said respecting the exercise of dogs, as, when they are taken out, as they should regularly be every day, they are ready enough to exercise themselves, and the chief care of the attendants consists in preventing them from straying or doing mischief. Hounds and greyhounds require the most exercise, and next to them pointers. An ordinary walk of about an hour will in general be sufficient for others.

From the directions already given for securing the proper ventilation of stables, byres, and kennels, with the remarks on exercise, it will appear how necessary free and pure air is to the health of domestic animals. Besides these remarks, it must be observed, that when the animals quit their places of confinement, the doors and windows should be thrown freely open to purify the internal atmosphere, which, after every precaution, is still more or less contaminated, in proportion to the number of their inhabitants. As moisture is very prejudicial to all these animals, care should be taken to remove it whenever it occurs, by mopping the floors, and by occasionally introducing chaffing-dishes with burning coke or cinders.

*Cleanliness* in the habitations and persons of domestic animals is essential to their health and comfort. Dung and other nuisances shonld be regularly removed from the former every morning, and only such part of the litter be retained as appears clean and dry. The floors, mangers, and troughs should be washed at least twice a-week, and the walls white-washed three or four times a year. The method of cleaning horses is well known, and the same method has been employed with advantage for cows, and might be extended to confined cattle. Sheep are not fond of the external application of water, and it is seldom employed except as a prelude to shearing; but where there is a convenient running stream, an occasional ablution during the summer months will materially contribute to clear the skin, and destroy the insects by which it is apt to be infested. Most dogs readily take the water, and every opportunity should be embraced of encouraging them to do so. Lap-dogs and others much confined to the house, except Italian greyhounds, should be washed with white soap and water about once a-week, and all should be frequently combed and brushed.

## PART. II. VETERINARY THERAPEUTICS.

### CHAP. I. OF THE REMEDIES EMPLOYED IN VETERINARY MEDICINE.

FOR an account of most of the following remedies, and of the classification according to which they are arranged, the reader is referred to MATERIA MEDICA in this work.

Many general *stimulants*, both internal, often called *cordials*, and external, are employed in various cases; some to refresh and recruit exhausted strength, as carbonate of ammonia, or *volatile salt*, dose a dram or two for horses and cattle, and half a dram for sheep; ale, and occasionally spirits, in the dose of a gill to half a pint, and Cayenne pepper half a dram: others to promote digestion and expel wind, as ginger, grains of Paradise, horse-radish, and the oils of cassia, cloves, peppermint, carraway and anise-seed; Barbadoes and common tar, generally given in an egg shell. The principal external stimulants are mustard, turpentine, oil of turpentine, hartshorn, corrosive sublimate, blue vitriol, and lunar caustic.

*Narcotics*, or anodynes, are employed both internally and externally, to relieve pain and procure rest. The principal are opium, dose for horses and cattle a dram, and about a scruple for sheep; laudanum, dose an ounce to half an ounce, and two ounces to one in a clyster; white poppy heads, chiefly for fomentation; extract of henbane, dose a dram or two; powdered hemlock applied externally in a poultice; and extract of hemlock, beginning with half a dram or a dram, and gradually increasing the dose. Tincture of soap and opium, or anodyne liniment, is a good external narcotic.

Several stimulants and narcotics are used as remedies in spasmodic and convulsive diseases, and are therefore called *antispasmodics*, as camphor, dose a dram or two; ether, dose from half an ounce to an ounce, mixed with water, and given expeditiously; Venice turpentine, dose an ounce or two; opium, and laudanum.

*Astringents* are used chiefly to repress morbid discharges of blood or other matters. Those used in veterinary medicine are chiefly, gall-nuts in powder, for external application; catechu, or Japan earth, from two drams to four; extract of logwood in a similar dose; alum, dose from half an ounce to an ounce; oak bark, used both internally and externally; and tincture of muriate of iron about a dram.

*Tonics*, or strengthening remedies, are given to confirm convalescence from acute diseases, or to strengthen the stomach and bowels. The principal are, extract of gentian, dose a dram or two, and quassia wood in a strong infusion; Peruvian bark, an ounce or two; horse-chesnut bark, the same; powdered myrrh, dose from two to four drams; salt or sulphate of iron, dose a dram or two, and the cold bath.

*Emetics* are scarcely used in veterinary medicine, except for dogs, and those animals, when they have free access to grass, seldom need any other vomit. Emetic tartar, in a dose of eight or ten grains, and turpeth mineral, or sub-sulphate of mercury, in that of half a dram, are commonly employed for dogs.

*Expectorants* are used in coughs and chronic affections of the chest; but little reliance can be placed on them. Those commonly employed are gum-ammoniac, dose three or four drams; assafœtida about half a dram; garlic, bruised or boiled; and powdered squill, dose about a dram.

*Diaphoretics* are occasionally given to increase the insensible perspiration in horses and cattle. Dogs, as is well known, never sweat; and horses are more easily made to do so, when required, by exercise and warm clothing than by medicine. The principal are, acetate of ammonia, or Mindererus' spirit, eight or ten ounces; camphor, sulphuret of antimony, about an ounce; antimonial powder about two drachms; nitre combined with camphor, and opium with ipecacuanha, in the form of Dover's powder, dose about a dram. These medicines should generally be accompanied or followed by a warm mash of bran and water.

*Sialogogues*, as such, are not employed in veterinary medicine, but several preparations of mercury, particularly calomel and mercurial ointment, are used for various purposes.

*Errhines* have been recommended and employed in some affections of the head in horses; but as their use is always preceded by bleeding and purging, it

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is probable that the advantage supposed to be derived from the former was to be attributed to the latter remedies, and they are therefore here omitted.

*Purgatives* form a very important division of veterinary remedies, suited to a great variety of cases, but requiring some caution in their administration to horses. From the length and convolutions of the bowels in these animals, bodies not very digestible may remain in them a long time, at least 24 hours, and strong purgatives thus retained have been known to produce inflammation. Hence the practice of giving purgatives to horses at stated times, by way of preventing disease, is improper, and, except in alarming cases, none but the milder purges should be given them, or they should be given in the way of clyster. The principal purgatives are Barbadoes and horse aloes, dose from half an ounce to an ounce, for cattle and horses; castor-oil, about a pound for ditto; jalap, chiefly for dogs, 20 or 30 grains; rhubarb, for sheep, a dram; common salt, in clysters; Castille soap, sulphate of soda, or Glauber's salt, about a pound in clysters; sulphate of magnesia, or Epsom salt, the same; and calomel, a dram or two usually with others.

*Diuretics* are much employed, especially for horses, not only in dropsy but in other affections. The following are the most common: Balsam of copaiva, dose about an ounce; Venice turpentine; oil of turpentine, an ounce or two; rosin, chiefly to cart horses; nitre, about an ounce; carbonate of potash a dram or two, and Castille soap.

*Of Epispastics*, or blistering remedies, the principal are Cantharides, or Spanish flies, which are much used both for blisters and rowels or issues, in the form of ointment.

The principal *diluents* are water-gruel, barley-water, and lintseed tea, which also act in some measure as *demulcents*; and to this last head belong gum-arabic, gum-dragant liquorice-root, and marshmallow-root.

The most powerful *emollients* are, the warm-bath, fomentations, and poultices, the last of which are generally made of oatmeal, barley-meal, or lintseed-meal, and to these may be added hogs-lard and olive oil.

Few *anthelmintics*, or worm medicines, are required in this department, and those chiefly for dogs. They are either purgatives, such as castor-oil, dose for dogs an ounce or two, gamboge about half a dram, jalap and calomel, dose half a dram, or mechanical remedies, especially powder of tin.

Of the *antacids*, or absorbents, the principal are carbonate of ammonia, lime-water, and prepared chalk.

*Refrigerants*, or cooling remedies, are used chiefly for external application, in the way of lotion. Such are, sal-ammoniac, sugar of lead, or goulard and vinegar; but some, as nitre, sulphuric acid, and muriatic acid, or spirit of salt, are given internally in a diluted state.

Of *escharotics*, or remedies used to destroy morbid excrescences, the principal are, lime, butter of antimony, and nitric acid; and, by way of antiseptics, yeast or barm, charcoal, and the mineral acids, are employed.

Some other remedies, chiefly external, which are not reducible to the above heads, remain to be enumerated: these are, powdered glass, white lead, diachylon plaster, oil of bays, staves-acre, oxide of zinc, prepared calamine, and sulphur.

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In marking the usual doses of remedies, the quantity stated in the above enumeration, where not otherwise specified, is intended for horses, or cattle of the ordinary size. When the same remedy is to be given to a sheep, from one-fourth to one-half of the smallest dose mentioned will in general be sufficient, and rather less will commonly answer for large dogs. A proportionally less dose must be given to smaller dogs.

## CHAP. II. OF THE USUAL FORMS OF VETERINARY MEDICINES.

What may be called the extemporaneous forms of veterinary medicines, which here require to be explained and illustrated, are powders, balls, drenches, clysters, lotions, fomentations, poultices, and ointments.

The form of *powder* is seldom employed, and only when the substance so to be administered can be mixed with the ordinary food, without imparting to it any very disagreeable flavour, such as antimony, sulphur, and anise-seed meal. Powders should always be very fine, and be slightly moistened before mixing with the food. They are generally thus given to horses, some of which take them very well; and to those who reject them, the medicines must be given in other forms. Powders are also used externally to heal excoriations, or remove specks from the eye-ball. See Part III. Chap. II. Sect. 2.

The *ball*, or bolus, is a very common and convenient form for giving a great variety of remedies, which will make a coherent mass with water, syrup, or treacle. It should be of such a consistence as to be easily rolled into a round figure, and dissolved by the juices of the stomach, and of such a bulk as the animal can readily swallow. Balls should be prepared only a short time before using, that they may not be too hard, and may readily yield in being swallowed. In giving a ball to a horse or to cattle, the mouth is to be kept open by an iron ring, large enough to admit the hand when contracted, and the person holding the ball between the thumb and finger of the right-hand, and drawing out the tongue of the animal to one side and downwards with his left-hand, he places the ball behind the root of the tongue, then lets go that organ, raises the animal's head, and removes the iron. Where drink is required with a ball, it must be given first; and if the ball contain irritating ingredients, the drink should consist of one of the mucilaginous diluents.

*Examples.—Cordial-ball,* Anise-seed meal half an ounce, powdered grains of Paradise three drams, powdered ginger a dram, treacle enough to form a ball. Horse or Cow.—*Anodyne* B. Opium a dram, anise-seed meal half an ounce, Castille soap scraped, two drams, water enough to make a ball.—*Astringent* B. Powdered catechu two drams, alum half an ounce, ginger a dram, Castille soap two drams, water enough to make a ball.—*Tonic* B. Powdered horse-chesnut bark an ounce, myrrh and Castille soap each a dram, water a sufficient quantity.—*Expectorant* B. Gum-ammoniac three drams, powdered squill a dram, made up with treacle.—*Diaphoretic* B. Emetic tartar a dram and a half, camphor half a dram, opium 20 grains, ginger two drams, made up with treacle. In hide-bound horses.—*Purging* B. Barbadoes aloes half an ounce, compound powder of tragacanth two drams, ginger a dram, made up with syrup.—*Diuretic* B. Camphor, oil of juniper, each a dram, rubbed together, Castille soap three drams, nitre half an ounce, made up with flour.—*Worm* B. Calomel, jalap, each half a dram, fresh butter enough for a ball. For dogs.

*Drench*, or drink, is the most common form in which internal fluid medicines are given. It is suited to all those remedies which are easily soluble or diffusable in a watery liquor, or which may be mixed with it through the medium of some mucilaginous substance, provided they have not a very acrid or disagreeable taste. In preparing it, the ingredients must be made as fine or smooth as possible, and intimately mixed. It is best given with a cow's horn, the large end of which is cut like a spout and made quite smooth. The animal's mouth being opened, the tongue drawn to one side, and the head a little raised, the drench is poured down his throat.—Drenches are improper, from the difficulty of giving them, in inflammatory affections of the mouth or throat.

*Examples.—Antispasmodic drench*, Camphor a dram dissolved in two drams of essence of peppermint, water a pint, ether half an ounce added at the time of giving. Horses and cattle in cramp of the stomach.—*Tonic D.* Salt of iron two drams, infusion of two drams of quassia, a quart.—*Emollient D.* Olive oil, mixed with the yolk of an egg, two ounces, powdered gum arabic half an ounce; decoction of marshmallow root a pint.—*Cooling D.* Nitre an ounce, emetic tartar a dram, water-gruel a pint or more.

*Clysters* are very convenient and useful medicines, calculated for administering remedies of almost every class. In quantity they should be proportioned to the size of the animal, from a quart or more to half a pint. They are best given by means of a syringe of wood or pewter, furnished with a smooth bone pipe of a proportional size and length. When there is reason to suppose that the bowel is obstructed by hardened faeces, they should be removed, in large animals, with the hand, or with a smooth horn spoon sufficiently long.

*Examples.—Narcotic clyster*, Laudanum, an ounce or two; water-gruel, a quart. This acts also as antispasmodic and astringent.—*Purgative C.* Glauber's salt, a pound; water gruel, a quart or more; olive oil, two ounces.—*Emollient C.* Water-gruel, boiled with two ounces of starch, a quart; laudanum, two drams.

*Lotions* or washes are external fluid medicines, employed chiefly as stimulants, astringents, or refrigerants.—*Examples. Stimulating lotion*, Quicksilver one ounce, aquafortis two ounces, combined in a gentle heat, and diluted with soft water.—*Astringent L.* Blue vitriol an ounce, water half a pint, sulphuric acid ten drops.—*Cooling L.* Sugar of lead two drams, vinegar four ounces, water a pint.

*Fomentations.—Anodyne F.* Bruised poppy heads and chamomile flowers four ounces, boiled in a gallon of water, and strained. The ingredients, with a little lard, form a good poultice.

*Poultices.—Emollient P.* Lintseed meal any quantity, boiling water enough to form a poultice, over which is to be spread a little hogs-lard.—*Antiseptic P.* Fine oatmeal, powdered charcoal, each four ounces; thin yeast enough to make a poultice.

*Ointments and liniments* are used either as stimulating remedies or emollients for dressing wounds or ulcers, or for destroying vermin. *Examples.—Stimulating O.* Hogs-lard four ounces, oil of turpentine an ounce.—*Stimulating L.* Oil of turpentine, olive oil, each two ounces. *Cooling O.* Sugar of lead, finely powdered, an ounce, palm oil half a pound.

## PART III. VETERINARY PRACTICE.

Before attempting the cure of any but slight diseases in domestic animals, it is proper for the proprietor to consider how far the cure is probable, and, if so, whether the expense and trouble attending it may not equal or exceed the price which the animal, when sound, would bring. If the case appear desperate, or if the cure is likely to be protracted and expensive, a prudent and compassionate person will rather put a period to the animal's sufferings, and thus at the same time consult his own interest, except in the case of a favourite horse or dog, whose life he may think worth preserving at any price.

As the diseases affecting domestic animals are very numerous, considering their mode of life and the simplicity of their diet, and many of them have little or no analogy in human medicine, they are here treated of under two principal divisions, the first comprehending the more simple and symptomatic affections arranged in the order of the functions, and the second the more complicated diseases. But, before entering on the diseases, it is necessary to describe the surgical operations which are usually performed, either as remedies or for some real or fancied improvement in the animals.

### Chap. I. Of Veterinary Surgical Operations.

The operations resorted to as remedies are chiefly bleeding, making of the rowels and setons, and firing; to which may be added, assisting the delivery of mares and cows in difficult labour, and worming of dogs. The only operation which is attended with any real improvement is castration, for an account of which we must refer to the writers on farriery and the management of cattle and sheep. Two operations, docking and cropping, are performed with the supposed view of improving the appearance of horses and dogs, and will be briefly noticed here.

*Bleeding* is a very important remedy in veterinary as well as in human medicine, especially in febrile, inflammatory, and spasmodic diseases, and there is some nicety in the mode of performing the operation. It is generally done with a common fleam struck into the vessel with a stick; but it is neater and most certain to use a spring fleam of a size proportioned to the vessel to be opened. The vessel usually opened in the horse, cow, and sheep, is the jugular vein, which runs superficially along the side

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of the neck; in dogs a vein of the foot, or, when any considerable evacuation of blood is required, the temporal artery. No ligature should be applied round the neck before opening the jugular vein, as an accumulation of blood in the head is thus produced. All that is necessary to secure a flow of blood, is for an assistant to press with one or two fingers on the vein, an inch or two nearer the shoulder than where the opening is to be made, while the operator, smoothing down the hair over the vein, applies the fleam, and opens the vein. Where the common fleam and stick are used, it is proper first to hoodwink or blindfold the animal, to prevent his starting. When the vein is opened, the pressure must be continued, and the blood should be received into a vessel of known capacity, that the quantity may be ascertained. When the proper quantity has been taken, the opening in the vein is to be secured with a *silver* or steel pin, with a sufficient quantity of coarse *linen* thread wrapped and tied round it. When a vein in the foot is opened, a ligature must be tied above the proposed orifice; and it may be necessary to place the foot in warm water, to encourage the bleeding. The temporal artery, which may in general be easily felt beating a little behind and above the outer corner of the eye, is best opened with a common lancet; and, to stop the bleeding, continued pressure must be made by a compress and bandage, or the vessel must be cut across.

In making *rowels* or issues, an opening in the skin is made with a penknife, or pair of sharp scissars; and a circular piece of smooth leather, covered with basilicon ointment, and having a hole in the middle, is introduced between the skin and flesh, separated for that purpose. A piece of caddice, spread with the same ointment, is then placed over the central hole, and the part is covered with tow and a bandage. In about three days the dressings are removed, and suppuration will be found to have taken place, when the leather must be removed, wiped, covered again with ointment, and replaced with the same dressings and bandage. The leather must be removed every day or two, according to the degree of suppuration, and the dressings renewed as before. *Setons* are employed, like rowels, to keep up a drain of matter in cases where such an evacuation is found useful; and they are also used for gradually emptying close sores or abscesses. They are made by raising a portion of the skin and perforating it through both sides with a flat needle, carrying several threads, to form a cord, moistened with basilicon. The cord is then drawn to within an inch of one extremity, and the rest is coiled up and secured below the dressings, to be drawn forward daily, cutting off the part that has imbibed the matter. When one cord is exhausted, another, if necessary, is easily introduced by means of an eye probe.

*Firing* is the application of a hot iron, or what surgeons call the actual cautery, for the purpose of stopping external hemorrhage, promoting the separation of mortified parts, in wounds of the joints, in indolent swellings of the bones or sinews, and for destroying the poisonous saliva, after cutting out the bitten part, in wounds inflicted by the teeth of rabid animals. The irons employed are of various forms, suited to the parts to which they are to be applied, and are generally heated to redness.

Assistance in *difficult labour* is frequently required by cows, and occasionally by mares; and both should be carefully watched on the approaching period of calving or foaling. In these animals, the natural presentation of the young is with the head and fore feet foremost, the nose being between the feet, and the back upwards; and whenever any other parts are found to present, it must be considered a cross birth, and will, in most cases, require assistance. The least unfavourable of these cross births is where the tail is foremost, and next to that the fore feet without the head. Whenever labour appears difficult or protracted, examination should be made with the hand and arm, previously dipped in warm water, and moistened with hog's-lard. If the difficulty appears to arise from an unusual size of the young, or from the rigidity of the parts, it may be necessary, especially during a first labour, to draw a quart of blood; and the throes of the animal must be assisted by gentle pulling, where the presentation is natural or reversed. In cross births the young must be turned, if possible, before any more active assistance be afforded. In some cases it is necessary to employ an instrument, called, from its form, the hook; and where extraction of the young entire is impracticable, it must be brought away piecemeal. But these cases should be entrusted to none but the most experienced veterinary practitioners. At these times the animal must be provided with plenty of clean dry litter, and clean water, and after a difficult labour it will be proper to give a warm mash.

What is called *worming* of dogs consists in cutting out a ligament from below the tongue, by first slitting the skin with a lancet, then raising the ligament, or *worm* as it is called, with an awl, and gently drawing it out entire with a cloth. The effect of this operation is not, as some suppose, to prevent the dog from going mad, but, on such an event taking place, to make the tongue swell, so that the animal cannot readily close the jaws to bite. It should be performed when the dog is only a few weeks old.

*Cropping*, or cutting the ears of horses and dogs, is, in general, a cruel and useless operation; but as it may occasionally be necessary, and will probably always be adopted, it is proper to explain how it may be most expeditiously and safely performed. The ears of dogs are best cut with a pair of surgeon's scissars. It should be done when the dog is very young; and only so much of the hanging cartilage should be taken away as to allow the remainder to stand erect. In cropping horses, a particular instrument called a *cropping iron* is used; and the same remark applies with respect to the portion cut off, which, in all cases, should be merely the outer edges of the cartilage. The wounds soon heal; but it will be proper to keep a horse under this operation cool and on low diet.

*Docking*, or cutting off part of the tail, is another unnatural operation, to which dogs and horses are commonly subjected. In the former the operation is very simple, and is performed either by biting off part of the tail at a joint, or pinching it off with a pair of pliers, such as are used by bell-hangers.

This method is better than using a knife, as the bleeding is less, and the wound easily heals. The docking of horses is best done with a chissel and mallet; and as the bleeding in these animals is considerable, it must be checked by the application of a red-hot iron ring to the stump. It is thought adviseable to dock young lambs, to prevent pinning.

## CHAP. II. OF THE MORE SIMPLE DISEASES OF DOMESTIC ANIMALS.

### SECT. I. *Of the Diseases affecting the Organs of Motion.*

*Wounds*, simple incised wounds, or such as are inflicted by a sharp cutting instrument, are not common in domestic animals, except in cavalry horses in the field of battle. A flesh wound of this kind, when small, is easily healed by drawing the edges together with strips of strong sticking plaster. If large, a flat hooked needle and waxed thread will be required; and if any considerable vessel has been cut it must be tied, to prevent a dangerous bleeding. After these precautions the wound must be carefully covered from the air with a compress and bandage, first placing over the wound a pledget spread with simple ointment. In two or three days the part should be examined, to see whether the edges of the wound adhere; and if so, in small wounds, the dressings must be removed; but if the adhesion have not taken place, or be only partial, fresh strips of plaster must be applied, and the wound dressed as before; and where matter forms, the dressing must be repeated every day or two till the wound be healed. Bruised, or lacerated wounds, are more common, especially about the knees, and they do not admit of sticking plaster or ligatures; but after being carefully examined to see whether sand, pebbles, or dirt have entered, and in that case removing such bodies, and carefully washing the parts, or whether the joint be laid open, the wound must, in the former case, be dressed with simple ointment, compress, and bandages, applied only sufficiently tight to keep on the dressings, and, in the latter case, must be treated as presently directed. If any considerable inflammation should come on, a poultice is to be applied, and repeated frequently, till matter is formed. If proud flesh form, or the edges become callous, in the progress of the cure, they are to be sprinkled with red precipitate, or touched with blue vitriol or caustic. Wounds of the joints, when large, are commonly incurable; but, in other cases, a successful method of treatment has been introduced by Mr Coleman. This consists chiefly in repeatedly applying to the outer soft parts an iron rod with a rounded end, heated moderately red, taking care that the iron do not touch the ligaments, and then defending the wound with the usual dressings. The treatment is minutely explained in Mr Coleman's paper in the first number of the *Transactions of the Veterinary College.* Punctured wounds, or those inflicted by a pointed body, as a nail, thorn, piece of glass, or a sharp stone, are considered the most dangerous, as they are often difficult to heal, and are sometimes followed by alarming spasmodic affections, which may prove fatal. The foot is commonly the seat of these wounds; and they are often occasioned in the horse by a nail in shoeing, driven in a wrong direction, so as to penetrate to the quick. If this accident be immediately discovered, as it may easily be from the flinching of the horse, and if the nail be drawn out, no evil generally follows; but if it be neglected, great irritation and pain are excited, followed by lameness, inflammation, and suppuration within the foot. An extensive internal suppuration of this kind is called a quittor, and is very difficult to heal. When there is reason to expect, in sheep and dogs, that they have been wounded by a thorn, the part should be carefully examined to see whether the thorn remain in the wound, and if so it must be immediately extracted. In these punctured wounds it is proper to enlarge the external opening, by making a free cut, to prevent matter from lodging; and the part may be kept open by a sponge tent, till the internal wound heals. In the wounds of the feet, the foot should be kept, for some hours, in pretty warm water, or should be frequently fomented, and covered, in the intervals, with a warm poultice. If the inflammation be considerable, blood should be drawn from a vein in the foot, and the animal kept low. If, in spite of these precautions, suppuration takes place within, an opening must be made in a depending direction to let it out. Punctures of the tendons and ligaments are the most dangerous, and are best treated with fomentations and poultices, followed by the application of stimulating ointments.

*Bruises*, when extensive, are followed by violent inflammation, which not unfrequently ends in mortification. In these cases, the bruised part must be repeatedly fomented, and, if the inflammation runs high, it will be proper to take blood from the nearest convenient vein. The fomentations must be continued, with occasional poultices, till the inflammatory symptoms subside, or suppuration take place, or till decided marks of mortification appear. In case of suppuration, the affected part forms what is called an *abscess*, and as soon as the matter it contains approaches the surface, an opening must be made with a lancet, or by means of a seton, to drain off the matter, and the wound must be treated as presently directed for ulcers. If mortification should ensue, warm poultices must be repeatedly employed while the strength of the animal is supported by the most nourishing food and occasional cordial medicines. The separation of the mortified parts is promoted by firing, round their margins, with the edge of a flat iron, shaped like a thick knife, heated moderately red. Slight bruises on the fleshy parts are soon discussed by fomentations; and a bruise on the heel or other part of the foot, called in horses a *tread* or *overreach*, from the manner in which it is commonly produced, is best treated by keeping the foot for a considerable time in warm water.

*Sprains*, or *strains*, may take place in the muscles, ligaments, or tendons. They are most common in the horse, and usually proceed from great exertions in leaping, attempts to prevent or recover a fall, or to extricate the foot from a hole or bog. They are generally distinguished by the sudden swelling and lameness that take place, without any shortening of the limb or crackling of the bones. One of the most common muscular sprains is that of the shoulder, called improperly a *shoulder-slip.* In this case blood should be freely drawn from the plate vein, and a purge given, after which the shoulder should be fomented for a long time, and the horse be kept on a low diet. If, after repeated fomentations, the swelling do not subside, a rowel is to be made below the shoulder, and stimulating liniments should be rubbed on the swollen part. A strain of the back sinew, or flexor tendon of the heel, is a very serious accident, and occasions long and sometimes permanent lameness. Bleeding, fomentations, poultices, and rest, are the chief remedies. A similar strain, called the *stifle*, sometimes happens in dogs, from being entangled in a gate or stile, and requires the same remedies.

A *rupture* of the flexor tendon, or of the adjoining ligaments, is still more serious, and in the larger animals generally incurable. It is known by the difficulty or impossibility of bending the foot, or supporting the weight of the body on it. This happens chiefly to horses, who are then said to *break down.* In the hands of a skilful veterinary surgeon, this may perhaps be cured; but if the horse be not of great value, it is *cheaper* to kill him.

*Fractures*, or broken bones, may occur in all the domestic animals; but except in fracture of the ribs, which may, in general, be cured by the application of a broad girth or bandage, the broken parts can scarcely be kept so steadily together in the larger animals as to effect a perfect union. This may, in general, be done in the limbs of the sheep and dog, by placing the broken ends of the bones exactly together in their natural position, applying on each side a piece of pasteboard, long enough to extend an inch or more beyond the fracture, and lined with tow or wool, and securing these by a bandage, applied so tight as to prevent the motion of the divided parts, but not to produce swelling. The bandages must be kept on for about a fortnight; but if the part should swell, they must be slackened, and the dressings wetted frequently with a lotion of sugar of lead. When the bone has united, the pasteboard may be removed, but the bandage should be continued for some time till the limb recovers strength. *Compound* fractures, where, besides the broken bone, there is an external wound, scarcely admit of relief in the inferior animals.

*Dislocations* are not common in these animals, except in the dog; and they require great skill in the treatment. They must therefore be left to the surgeon.

*Stiffness* often remains after many of the accidents now enumerated. In general, it may be removed by rubbing the part twice a day with camphorated oil, opodeldoc, or camphorated mercurial ointment; but if it prove obstinate, recourse must be had to repeated blisters, rowels, or setons.

*Ulcers,* or open sores, are the common consequence of inflammation, and often occur from wounds, bruises, sprains, and other accidents; but they also occasionally take place without any such exciting cause. In most cases they arise from an inflammatory swelling proceeding to suppuration, and forming an *abscess,* which, when it bursts, or is opened, becomes an ulcer. The treatment of ulcers, in the inferior animals as well as man, depends on their situation and appearance, and the nature of their discharge. If they be superficial, shew healthy granulations or new flesh, and produce thick, white, or yellowish matter, they require only simple dressings, as caddice spread with cerate or basilicon, a pledget of tow, and a bandage, renewing the dressings once a day. Callous edges, and proud flesh, must be treated as directed under wounds. If the surface appear dry without a disposition to fill up, poultices will be proper, and when the ulcer is painful or irritable, powdered hemlock should be added to the poultice. If the discharge become thin and coloured, it will commonly be improved by sprinkling on the sore, before applying the usual dressings, a little powdered rhubarb or Peruvian bark. Sometimes long pipes, or *sinuses,* running inwards, are connected with the ulcer; they must be laid open, and a compress and bandage must be applied over them to bring their sides together, or, if their situation do not admit of being so pressed, tents of a proper size must be introduced, and cleaned or renewed every day.

*Running thrush* is an oozing from the cleft of the frog in horses, and between the toes in cattle and sheep. When slight, it requires only an attention to cleanliness; and, if the discharge increase, the part must be washed frequently with a solution of white vitriol, or some other astringent lotion.

*Canker,* or *fouls,* is a fungous irritable ulcer of the foot, with a discharge of offensive matter, very apt to spread upwards, and occasion the loss of the hoof, or even of the toe. It requires prompt and active treatment, which consists in paring away the horn, and as much of the fungus as extends beyond the surface, and applying to the parts a piece of caddice or linen wetted with a strong solution of lunar caustic, or the mercurial solution mentioned under *Lotions,* confining the dressings by a bandage, or, in the horse, by cross bars of iron inserted below the inner edges of the shoe. The application must be repeated till the sore shows a disposition to heal, and it should then be treated as an ordinary ulcer.

*Foot-rot* in sheep belongs to this head,—but as it is now supposed to be contagious, it will more properly be considered under *Inflammations* in the next chapter.

*Corn* is the name vulgarly given to a painful inflammatory affection, accompanied with an internal effusion of blood, that often takes place between the horny and the sensible sole in the foot of horses. It is known by a peculiar tenderness in the foot, and, on taking off the shoe, by a discoloured spot, pressure on which makes the horse flinch. It is generally caused by a stone remaining for some time between a hollow shoe and the horny sole, producing an unnatural pressure on the sensible sole. It is cured by removing the shoe, paring the horny sole up to the effused blood, then keeping the foot for some time in warm water; applying to it a pledget wetted with tincture of myrrh, and replacing the shoe after cutting out the part opposite the sore. After this the horse must be allowed to rest for some days, or till the horny sole grow firm enough to bear a new shoe.

*Bony excrescences* occasionally appear in various parts of the limbs, called *splents* near the knee, *bone-spavin* and curb near the hough, and *ring-bone* on the lesser pastern bone round the coronet. These swellings are attended to chiefly in the horse, as they not only disfigure the animal but produce partial lameness. Attempts have been made to remove them by exciting the absorbents with repeated blisters, or frictions with camphorated mercurial ointment, but they seldom succeed; and the most effectual method is to cut off the excrescence with a sharp chissel and mallet, after laying it bare by a free incision, and then healing the wound as fast as possible, by sticking plaster, and firing the surrounding skin.

*Founder.*—Another inflammatory affection within the hoof, brought on usually by long and hard labour on hard roads, is called *founder*, or the animal thus affected is said to be foundered. In this complaint the animal moves with pain and difficulty, especially at first setting off. A horse thus affected in the fore feet throws his hind feet unusually forward, and when the latter are the seat of the disease he rests more and longer on the fore feet. The chief remedies, after removing the shoe and paring the hoof, are, bleeding from the foot, fomentations, poultices, blisters, rest, and low diet.

*Windgalls, &c.*—These animals, especially horses, are subject to enlargements of the mucous bags or capsules, which furnish the lubricating fluid, or *synovia*, of the joints. These swellings are called *windgalls*, when situated near the pasterns; *bog-spavin*, when on the inner side of the hough; *thorough-pin*, when on the upper and back part of the hough; and *capulet* when near the point of the hough. The treatment is the same in all. In slight cases, the repeated application of blisters will, in general, discuss the swelling; but if this be considerable, the accumulated fluid must be let out, and the wound thus made must be treated by firing, &c. like other wounds of the joints.

### SECT. II. *Of the Diseases of Sensation.*

*Increased sensibility* to impressions, shewn by starting or shying, is not uncommon, especially in horses. It generally proceeds from high feeding or bad treatment, and is then best combated by lowering the diet, lying hard in a well aired stable, and gentleness. In dressing, an old currycomb should be used, and only where necessary. *Restlessness* is commonly a sign of some approaching acute disease, or of the fatal termination of a dangerous chronic affection; but sometimes it is the only obvious complaint, and, in this case, generally arises from nervous weakness, and requires free air, gentle exercise, nourishing diet, and strengthening medicines for its removal.

*Low spirits* in these animals is commonly the effect of fatigue or bad and low diet, and must be counteracted by rest and nourishing food.

*Drowsiness* generally indicates fullness in the vessels of the head, and yields to bleeding and purging. *Giddiness* may also arise from the same cause, and requires similar remedies; but sometimes it is the consequence of weakness, and calls for an opposite treatment.

*Blindness* is considered worthy of attention, chiefly in the horse and dog. It is either partial or total, and the former is regarded as the worse, especially in the horse, whom it renders dull, timid, unsteady, or restive; he starts at every object, carries his head very high, is particularly fearful in passing carriages, treads with caution, and trips or stumbles in roads comparatively smooth. Partial blindness may be produced by plethora, weakness, inflammation, or specks on the front of the eye. In the first two cases a cloudiness of the eye, and in the first an unusual prominence of that organ, is generally perceptible. The last two causes are obvious on inspection. The first is to be combated by bleeding, purging, blisters, and low diet; the second by the reverse treatment; and the third by the methods afterwards described under inflammation. Specks on the cornea are best removed by blowing between the eye-lids, with a quill, a powder composed of equal parts of finely powdered glass and white vitriol, once or twice a-day till they disappear. Total blindness is of three kinds, according to the seat and immediate cause of the disease; *amaurosis*, or glass eyes, in which the retina or expansion of the optic nerve is insensible to light, though the coats and humours of the eye are clear; *cataract*, or *moon-eyes*, in which the lens in the centre of the eye has lost its transparency, and appears dull and opaque behind the pupil; and *wall-eyes*, in which the cornea is opaque or clouded. The first kind is probably altogether incurable; and though the second may be removed by an operation, the animal's vision would still be imperfect. An attempt may be made to cure the third kind, by scarifying the vessels, blisters to the temples, and stimulating applications to the eye; but it seldom succeeds.

### SECT. III. *Of Simple Diseases affecting the Organs of Digestion.*

*The mouth* is sometimes sore or affected with chaps or cracks, so as to render chewing painful. These affections require a wash of salt and vinegar, or alum, applied by means of a rag fastened to one end of a stick. *Tumors*, or excrescences, are sometimes observed in the mouth; and, if they prove very inconvenient, they must be removed by tying round their base a piece of waxed thread, and tighting it daily till they drop off.

*Choaking*, or an obstruction of the gullet, by a morsel too large to be easily swallowed, often happens to cattle fed on turnips or raw potatoes. This accident requires prompt assistance; and cattle-feeders should always have ready an instrument, or *probang*, for *unchoaking* or forcing the morsel down the throat. The most convenient probang is formed of three pieces of slender cane lashed together with shoemaker's waxed thread, and having a piece of sponge of different sizes securely fastened to each end, by passing a strong thread through the centre of the sponge, and through holes made in *each* of the canes. The small end will do for sheep, and the larger for cattle. The sponge being well greased, the probang is introduced into the throat, and pressed gently forward till it touch the obstacle, which a little more force will generally make pass into the stomach.

*Flatulence.*—Distension of the stomach by air extricated from fresh vegetable food in a state of fermentation, is often a very serious affection in horses and cattle, as, from the peculiar structure of the digestive organs in these animals, the air thus produced is not easily expelled, and when much accumulated occasions severe pain, and a violent determination of blood to the head, which may terminate in apoplexy, or sometimes the stomach bursts from over-distension. This affection is generally called *over-feeding*, or the *fog-sickness*, and cattle thus affected are said to be *hove* or *hoven*. It is often the consequence of drinking large quantities of water after filling the stomach with fresh grass or clover, and is known by the uneasiness which the animal expresses, and by the swelling of the belly, while there are no marks of fever. The air may be drawn off by introducing a flexible tube down the throat into the stomach, or by stabbing the animal in the region of the stomach with a surgeon's trocar, such as is used in dropsy of the belly. But when the accumulation of air has not proceeded to an extreme height, it may be arrested by giving to a horse or cow an English pint of gin or whisky, with as much water, by way of a drink; and a clyster of two quarts or more of warm gruel, with a tea-spoonful of oil of anise-seed, should be administered.

Indigestion and surfeit, not being properly simple diseases, will be noticed under *inabilities* in the next chapter.

*Rupture,* or protrusion of some part of the bowels, chiefly at the navel and groin, sometimes occurs in horses from sudden or violent exertions. A ruptured horse can never be depended on, as the increase of exertion may enlarge the swelling, and produce *strangulation,* (see SURGERY,) and no method has been contrived, or could perhaps be used, for preventing such an accident.

*Falling of the fundament* is not uncommon in horses or cattle who have been weakened by purging, especially if they be ridden or driven hard. The bowel, being first bathed with a solution of alum, or white vitriol lukewarm, must be carefully pushed back with the fingers covered with soft linen a little greased; and some of the same astringent liquor should be injected two or three times a-day, especially after an evacuation. The animal should be allowed rest, and costiveness must be prevented by warm bran mashes.

*Worms,* and other parasitical animals, occasionally infest the stomach or bowels of horses, cattle, sheep, and dogs; but only in the first and last are they usually an object of medical treatment. The symptoms attending the presence of worms are very obscure in these animals, unless traces of them be seen in what they pass. The most common worm, as it is improperly called, in the horse, is the grub of the horse gadfly (*Oestrus equi*) commonly called *bots.* That insect lays its eggs among the hair of the horse's fore-quarters, where they excite such a degree of itching, that the horse is induced to lick those parts, and swallows the eggs along with his spittle. The eggs are gradually developed in the alimentary canal into grubs, which are voided with the excrement. Few horses escape the attacks of these insects; and as nature has pointed out this method of propagating this species, it is not likely that they should, in general, be the cause of any dangerous disease. They may, however, under certain circumstances, excite much irritation, and even inflammation, in the stomach or bowels; and it is proper, when they begin to make their appearance, to keep the horse quiet, and promote the expulsion of the grubs by laxative clysters, and such solid food as may strengthen the alimentary canal. The tapeworm infests dogs, especially when young; and the best remedy is oil of turpentine mixed with fresh butter, in the dose of from two tea-spoonfuls to a table-spoonful, according to the size of the dog, twice a-day, till the worm is expelled.

### SECT. IV. *Of the Simple Diseases of Circulation.*

*Varieties of the pulse.*—The pulse of the inferior quadrupeds has been little attended to, though it affords a good criterion in judging of many of their diseases. It differs in frequency and strength according to the species, and still more the size of the animals, being generally quickest and weakest in the dog and sheep, and slowest and strongest in the horse and cow. The average velocity of the pulse of a healthy dog is from 90 to 100 beats in a minute; that of a sheep from 80 to 90; that of a cow from 40 to 50; and that of a horse from 35 to 45. The strength of the pulse is, of course, in proportion to the size of the animal; and its velocity, as stated above, is understood to apply to the animals when in a state of rest and quiet. It is of consequence that those who are employed about these animals should be acquainted with the natural state of their pulse, and prepared to judge of its irregularities. The pulse may in general be readily felt opposite the heart, on the left side of the chest, in the temporal arteries, behind and above the outer angle of the eye, at the outer corner of the lower jaw, on each side of the fetlock, or on the inside of the hough. The morbid varieties of the pulse will be particularly noticed, as symptoms, in the next chapter; but it is proper here to mention two opposite states of the system, which are distinguished chiefly by the state of the circulation: They are *plethora* and *debility.*

In *plethora,* or fullness of habit, the animal is sleek and plump, but dull, heavy, and inactive, short winded, and easily fatigued or over-heated. The pulse is strong and full, but sometimes slower than natural, and the superficial veins appear swollen and distended with blood. This state is the consequence of high feeding, want of work or exercise, and sleeping much on soft warm beds. It disposes to several acute diseases, especially those of an inflammatory and lethargic nature. If it have arrived at a great height, it will be proper to bleed and purge; but in mild cases, it is better gradually to abridge or lower the food, and increase the exercise or labour as the animal can bear it. *Debility,* or weakness, is marked by leanness or emaciation, a rough, contracted, or shriveled skin, a weak, small, and commonly frequent pulse, muscular weakness, low spirits, and an aversion to exertion. It is brought on by fatigue, low living, or profuse evacuations, and commonly follows a long or protracted illness. If not removed, it usually ends in dropsy, atrophy, palsy, or some spasmodic affection. It requires rest, nourishing diet given cautiously and gradually, and strengthening medicines, with pure air and moderate exercise.

*Wounds of arteries* are dangerous in proportion to the size of the vessel and the difficulty of getting access to it. If a small artery be only partially wounded, it should be cut across, and the bleeding will soon stop; but if the vessel be larger, or if the bleeding continue, the artery must be tied with a strong but single silk thread, both above and below the wound, and then cut across between the ligatures. Wounded veins, if large, should also be tied; but in general it is sufficient to remove the clotted blood, and secure the orifice, as after bleeding. In some cases it will be proper to fire the wound, especially if it should ulcerate.

*Aneurisms,* or throbbing swellings in the course of an artery, are most common in the neck and near the hough. They are usually the effect of great exertions in running, or drawing heavy weights. When such a swelling is observed, the artery must be laid bare by a free but cautious cut, and ligatures must be firmly applied both above and below the tumor, which should then be opened, and the vessel cut across between the ligatures. *Varicose,* or swelled veins, commonly called *blood-spavin,* are sometimes seen in horses, especially about the hough, accompanying *bog-spavin.* These swellings may sometimes be removed by continued pressure, but the only certain method is to tie the vein as directed for aneurism, and let out the blood from the swelled part.

### SECT. V. *Of Simple Diseases affecting the Organs of Respiration.*

*Snores,* or *snivels,* is an obstruction of the nostrils, occurring chiefly in cattle, by an inflamed swelling of the membrane, commonly the consequence of cold. As the swelling usually suppurates, and the difficulty of breathing through the nostrils is thus relieved, such termination should be promoted by the application of warm steam, inhaled from a bran mash put into an open bag, which is tied round the animal's nose, and renewed as often as it cools. The animal must in the mean time be kept warm.

*Chronic,* or habitual cough, without present inflammation, is not uncommon in old horses and in cows, and is excited or aggravated by cold air or unusual exertion. A variety of cough, attended with a peculiar roaring noise, and hence called a *roarer,* seems to be connected with a contracted state of the windpipe remaining after inflammation of that tube. These affections scarcely admit of a permanent cure, but may be relieved by warmth, light diet, gentle labour, a warm mash every night, and a drink in the morning of an ounce of tar mixed with a quart of warm ale.

*Thick wind* is a chronic difficulty of breathing, without cough, in which the inspirations and expirations are made in nearly equal time. It is a consequence of previous inflammation, and seems to be owing, like the roarer, to a contraction of the air tubes. It can only be palliated by the means just recommended for chronic cough.

A horse is said to be *broken-winded* when a slight exertion makes him pant and heave his flanks, while the expirations are longer than the inspirations, or when, on making him cough, by pressing the upper part of the windpipe, the sound produced is hoarse, rough, and roaring or whistling. The immediate cause of this affection is said to be a rupture in some of the air cells in the lungs, brought on, it is believed, by hard work with a full stomach. The best treatment in these cases is to avoid distention of the stomach, which always aggravates the complaint, by feeding the horse moderately, and chiefly on corn, allowing him very little water, and taking care never to put him into hurried motion. Occasional laxatives must also be given to keep the bowels open, but not loose.

### SECT. VI. *Of the more Simple Diseases affecting the Organs of Secretion and Excretion.*

*Incontinence of urine,* or inability to retain it, is very common in dogs, and sometimes occurs in horses. It is produced either by a paralytic affection of the neck of the bladder, or by a morbid irritability of that organ or the neighbouring parts. In the former case, it generally yields to repeated blisters applied over the region of the bladder, and, in the latter, if it be not connected with stone, to opiates and the warm bath.

*Suppression of urine,* or difficulty in voiding it, may arise from various causes, as inflammation of the bladder or kidney, (see *Inflammations*;) over-distention of the bladder, in consequence of neglect, when the water must be drawn off with a hollow pipe of a proper form, called a catheter, the belly must be fomented, and a purgative clyster given; from some organic obstruction at the neck of the bladder, which is probably incurable; or from calculous stone or gravel. This last complaint is not uncommon in dogs and horses, but only in the latter can the presence of a stone in the bladder be easily ascertained by examination through the rectum. In that case it may be removed by making a cut into the distended bladder above the pubis, and extracting the stone with a pair of pincers.

*Bloody urine,* sometimes called *red water,* or *black water,* is generally a symptom of inflammation of the kidney, which see in the next chapter.

*Costiveness,* or a bound belly, may take place in any of the domestic animals, but is most attended to in horses, as in them it more readily leads to colic and inflammation. It is best removed by laxative clysters, after taking warm mashes of bran, and feeding on succulent food, especially boiled carrots. When calves are costive, the chalk should be withheld, and magnesia be mixed with their milk.

### SECT. VII. *Of Simple Diseases of the Skin.*

The skin of domestic animals is subject to many affections of a chronic nature. Some of these affections are rather symptoms of other and more general diseases. Others are eruptions or *out-strikings,* and several are the effect of parasitical insects.

*Hide-bound* is an epithet given to horses whose skin is hard, dry, and tight. It is generally a symptom of some lingering disease, but may be the effect of neglect and improper food. In the latter case, the food must be changed for good grass and hay, with now and then a mess of boiled barley; strict attention to cleanliness must be observed, the warm bath should be used once a-day, and a bran mash with antimony given at night.

*Surfeit* is the name given to a scaly or a running eruption, on the skin of poor horses, who are hard worked and ill fed. It requires a similar treatment with the preceding affection, with the addition of frequent washing of the affected part with warm soap and water. Surfeit in dogs is a cutaneous affection, shewing itself in blotches; but it arises from a very different cause, namely, from eating putrid or diseased horse flesh. It requires the internal use of purgatives, and afterwards of train-oil mixed with an equal quantity of ox-gall, and frequent washing with salt water or a solution of sea salt. A scurvy eruption sometimes appears in horses not properly cleaned, about the knee or the bend of the hough, and is called, in the former situation *mallenders*, in the latter *sallenders*. It is removed by alternately washing the parts with soap and water, and anointing them with camphorated mercurial ointment.

*Mange*, scab, or itch, is an infectious eruption of the skin that commonly affects cattle, sheep, and dogs, and not unfrequently horses. It is marked by pustules or patches on the skin, appearing first in one part and breaking and gradually spreading over the whole surface, attended with intolerable itching, so that the animals scratch and rub themselves against any object that comes in their way. Horses, cattle, and dogs lose their hair in this disease, and in sheep the matter oozing from the pustules among the wool produces a thick *scab*, from which has arisen the common name given to the disease by shepherds. Animals affected with this complaint fall off very fast, from the irritation to which they are exposed, and proper measures cannot be too soon adopted to remove it. The first object, where several sheep or dogs are kept together, is carefully to examine every individual of the fold or kennel, and remove the affected animals to a separate place. They must then be well washed with warm water and black soap, but in sheep the matted wool must previously be cut or scraped away after soaking it, and the rest clipped short, and, after the washing, the whole skin is to be rubbed with ointment suited to the mildness or virulence of the disease. In mild cases, common sulphur ointment, or for sheep the same mixed with tar, or mild mercurial ointment, repeated once a day for three or four days, will generally effect a cure; but when the complaint has lasted long or spread much, the best application is an ointment composed of corrosive sublimate finely powdered, train-oil, and tallow, in the proportion of four ounces of the first, three gallons of oil, and three or four pounds of tallow, rubbing the powder well with part of the oil, and adding the rest melted with the tallow before it be quite cold. On the first application this ointment may remain on the skin three or four days, and should then be washed off with soap and water. If the eruption appear deadened, a second application will probably be sufficient, but otherwise a third will be required. With these external means, it is proper to give sulphur and perhaps purgatives internally, and allow the animal exercise and good wholesome food. A final washing will complete the cure. Cleanliness is the great mean of preventing the disease; and sheep are said to be protected by tar or smearing ointment.

Several parasitical insects attack the skin of the domestic animals, for the purpose of sucking their blood, or depositing their eggs; as lice, fleas, ticks, (*hippobasea ovina*,) the sheep-fly, the cattle gadfly, (*oestrus bovis*,) and the sheep gad-fly (*oestrus ovis*.) Even the itch has been attributed to the same cause. *Lice* infest chiefly calves and puppies. They are destroyed by mercurial ointment, or ointment of white precipitate. Fleas are most frequently found in dogs; they are kept under by frequent washing, combing, and brushing, and may in general be destroyed by a strong decoction of tobacco, or mercurial ointment, and oil of turpentine. Ticks attack both sheep and dogs, and require the same treatment as fleas. The sheep-fly bites holes in the skin of its victim, and there lays its eggs, which inflame the parts and produce ulcers, where the maggots are gradually hatched. When the ulcers are discovered they must be carefully opened, cleared of the maggots, and dressed with tar ointment. The *gad-fly* which attacks cattle produces the same effects as the preceding, but in a much more severe degree, as its bite occasions great pain, so that the animals who have experienced it are terrified and rendered furious, and the wounds inflicted are large and difficult to heal. The younger and more healthy cattle are chiefly attacked. The sores produced are called *puckeridge*, and the grubs they contain *wormils* or warbles. The best practice is to open the sores, and inject into them some oil of turpentine, and the next day rub them with basilicon, after which they soon heal. The sheep gad-fly is said also to attack the skin, but it more commonly assails the nostrils, which it irritates and inflames to a great degree. In the former case, the sores are to be treated as directed for the *fly*; in the latter, the nostrils should be washed with soap and water, and, when the inflammation subsides, rubbed with oil of turpentine mixed with olive oil.

*Felt-rot* is a complaint of sheep, brought on by long exposure to wet and poor feeding, by which the wool is destroyed and falls off, while the sheep pine and die, if not relieved in time. The remedy is to remove them to a dry situation, pull off the rotten wool, anoint the skin with tar ointment mixed with turpentine, and supply them by degrees with good wholesome food.

## CHAP. III. OF THE COMPLICATED DISEASES OF DOMESTIC ANIMALS.

In treating of the more complicated diseases incident to the domestic animals, the same arrangement will be adopted as has been employed in the concluding part of the preceding treatise, with the exception of heads which do not properly belong to this department, or have been already anticipated in the last chapter. The remaining heads, namely, fevers, inflammations, febrile eruptions, painful diseases, spasmodic diseases, lethargic diseases, general inabilities, and cachectic diseases, will form the subjects of the following eight sections. As it is presumed that the readers of this work who are desirous to acquire information on the practice of veterinary medicine will peruse the treatise on human medicine, it is necessary here only to treat of the particular diseases, and show how they may be distinguished, and point out what appear to be the most successful methods of treatment.

### SECT. 1. *Of Fevers in Domestic Animals.*

Only two species of fevers are observed in these animals, inflammatory fever and epidemic fever.

*Inflammatory fever* may occur in any of these animals, as symptomatic of approaching inflammation in some particular organ; but it is said that it is occasionally observed in the horse as a primary disease. The early symptoms are much the same in both cases;—dullness, heaviness, loss of appetite, restlessness, starting, disturbed sleep; frequent, hard, and generally full pulse; quick, but not always difficult, breathing; increased heat of skin on the trunk, and sometimes of the ears, with coldness of the limbs, especially at first; eyes heavy or red; excretions scanty and dark coloured; skin dry and rough; mouth dry and hot. Where no organic inflammation takes place, the symptoms either gradually subside, leaving a great degree of debility, or they continue for a few days, and then the heat abates and is succeeded by coldness; the pulse loses its fulness and hardness, but increases in frequency; the animal becomes drowsy, listless, and very weak, refuses food, and gradually pines and dies. In most cases of primary inflammatory fever, the prognosis is favourable. Its principal causes are, exposure to great heat, especially while under hard work, and exposure to cold and moisture when overheated. The treatment consists in early and copious bleeding, purging, rest, low diet, and exposure to free cool air. Lukewarm water should be frequently given, and at night a bran mash, in the water of which a dram of emetic tartar has been dissolved, taking care not to give it too warm. When the fever subsides, and weakness comes on, the strength must be supported by nourishing diet, and tonic medicines, with gentle exercise, as the animal is able to bear it.

*Epidemic*, or *putrid fever*, commonly called pest or murrain, is not a common disease, but it has sometimes raged like a plague among horses, and more frequently among cattle. It is a very peculiar disease, and its nature appears not yet to be well understood. It is even uncertain whether it should be ranked among fevers or inflammations, but it is generally considered as similar to *typhus* fever in the human subject. Its symptoms and progress have varied in different situations, and at different times. The following is an abstract of Dr Layard's account of the epidemic, as it appeared in Britain in the middle of the 18th century: The first symptoms observed were want of appetite, difficulty of swallowing, shaking of the head, hanging of the ears, dim and heavy eyes, and constant restlessness. After the fourth day, came on stupidity of appearance, aversion to motion, great weakness, running of the eyes and nose, total loss of appetite, sickness, bilious vomiting, a dry cough, and shivering, followed by heat of the head and horns, with hot breath, while the body and limbs were cold. The pulse was from the first frequent, hard, and small, and afterwards irregular; and the fever, after the first three days, was worst at night. Purging, fetid excretions, offensive breath, high coloured urine, and boils below the skin were among the later symptoms. About the seventh or ninth day a favourable turn sometimes took place, but in most cases the animals died soon after that period. Dissection shewed that inflammation and mortification had taken place in one of the stomachs and in the bowels, and the lungs were distended with blood. The disease has always proved very destructive, and appears to have been spread by contagion; but the other causes are uncertain. The treatment most likely to succeed appears to be to separate the infected animals from the herd, and place them singly, or in small parties, in roomy, clean, and well-aired byres or stables; bleed moderately and early, give a cooling purge if the bowels be bound, or a vomit if otherwise; wash the whole body with tepid water, and rub gently till it be dry; apply blisters or make rowels on each side of the neck near the head, and give every night a drench with emetic tartar. Mucilaginous drink must be freely allowed; but it is useless to offer food till the fever abates. When signs of weakness come on, the emetic tartar must be omitted, and opium and strengthening remedies be given.

### SECT. II. *Of Inflammations in Domestic Animals.*

Some or other of these animals are liable to all the inflammatory diseases which affect the human frame, and to a few peculiar to themselves. The former may be here very briefly discussed, as the observable symptoms, distinction, causes, prognosis, and treatment, are nearly the same as in man.

*Inflammation of the brain*, phrenzy, mad staggers, or megrim, is most common in horses and cattle. Along with the usual marks of inflammatory fever, there are signs of violent affection of the brain, shewn by inflamed or suffused eye, wild and terrified look, great agitation, frequent motion of the head, ungovernable temper, and afterwards by heaviness, drowsiness, and lethargy. Young animals are most subject to the disease, and it is usually brought on by great heat, violent exertion, or a sudden change from low to rich diet. The chief remedy is copious bleeding from the temporal artery, aided by purging, starvation, darkness, though with free air, and rowels in the neck.

*Inflammation of the eye* is easily distinguished by the appearance of that organ, especially by swelling of the lids, discolouration of the ball, and, in the horse, by enlargement of the body called the *how*, in the inner corner. In the horse it presents some peculiarities. It often affects only one eye, attacks periodically, and sometimes disappears and recurs without any obvious cause. It is most common in plethoric horses about five or six years old, especially such as are kept in dark stables, and suddenly exposed to a strong light. If not soon relieved, it often ends in blindness. In slight cases, this disease generally yields to purging, low diet, shading the eye, and frequently bathing it with an astringent lotion; but in the horse, in whom it is more a general than a local disease, general bleeding is commonly required; diuretics, as well as purgatives, should be given repeatedly, and a seton should be inserted as near the eye as possible.

*Catarrh*, or cold, occasionally attacks all those animals, but is most common in the horse and dog. It is marked by the same symptoms, and is brought on by the same causes as in man. It is seldom attended with fever. It may terminate in pleurisy, consumption, or thick wind, but in general requires only mild treatment, confinement within doors, a gentle purge, steaming the nostrils, giving a warm mash at night with emetic tartar, and covering the animal with a cloth or blanket. If the symptoms be severe, and especially if fever attend, both bleeding and purging, with low diet, will be proper; and the emetic tartar must be repeated every six hours in the form of drench.

*Influenza*, or epidemic catarrh, sometimes occurs among herds or flocks, or in crowded stables, and carries off several of its victims. In this disease the head is much affected, and there is usually considerable fever, followed by great weakness. It is uncertain whether the complaint be contagious or depend on a peculiar state of the atmosphere. At first the same treatment as for common cold may be employed, avoiding much heat, and adding blisters near the head; but as the fever subsides and weakness comes on, cordials and tonics will be necessary, and the diet should be improved. Air and gentle exercise will contribute much to renovate the strength.

The *distemper* in dogs has been compared with influenza, which it resembles in its early symptoms; but it differs in several important circumstances, in being accompanied by greater debility, and followed by a spasmodic or paralytic affection of the hind limbs, and in occurring only once in the life of the animal. The principal objects of its attack are puppies between six and twelve months old, few of whom escape it, and to many it proves fatal. It is supposed to be contagious. Its ordinary treatment is empirical, and the chief remedy is a powder prepared by Mr D. Blaine, and sold by the venders of patent medicines, with directions for using it. A combination of calomel and antimonial powder has been found of use, by vomiting and purging, and sometimes exciting sweat. Free air, and free access to mucilaginous drink, as gruel or weak barley broth, are necessary; and probably a warm bath, before giving the medicine, would be of advantage. In the advanced stage plenty of nourishing food, milk, air, and exercise, as the dog is able to bear it, is required.

*Pleurisy*, or inflammation of the chest, has little peculiar in the domestic animals, except in the horse, in whom, besides the usual symptoms, fever, thirst, difficult and painful breathing, and dry cough, it is marked by heaving of the flanks, and an inability or aversion to lie down. The cure depends chiefly on early and copious bleeding; and if that be delayed for three days, the disease generally terminates fatally. Purging is here less necessary than in most inflammations, and should be restricted to clysters. Blisters to the chest, and a weak drink of emetic tartar twice a-day will greatly contribute to the cure. Instead of blisters, it has been lately recommended to make an opening in the skin of the chest, inflate it, and inject into it a quantity of oil of turpentine, by way of counteracting the internal by external inflammation.

*Inflammation of the liver*, if it ever occurs, except as symptomatic, in domestic animals, is not easily distinguished; and probably it has often been confounded with the feverish affection that sometimes accompanies jaundice in horses and cattle, or pneumonic rot in sheep.

*Inflammation of the stomach* is not an uncommon disease in these animals, especially in horses and cattle, as appears by dissection after death; but its symptoms are so obscure as not easily to be detected, except the cause of the disease be obvious. It is extremely dangerous, and requires the most active treatment. It is generally produced by drinking cold water after being overheated, or by poisons. In both cases, it is necessary to bleed copiously and administer frequent emollient clysters, and in the former to apply fomentations to the belly. In the latter case, which usually occurs in horses and dogs, every thing will depend on ascertaining the nature of the poison. In dogs, this is probably arsenic or corrosive sublimate, and vomiting should be promoted by emetic tartar, and the animal should be made to swallow milk mixed with white of egg. In horses the poison is probably corrosive sublimate, and nothing can be done, unless a proper apparatus for evacuating the stomach, consisting of a flexible tube, to be passed down the gullet, and attached to a large bag of elastic gum, be at hand. In that case, alternate emptying the stomach, and pouring down gruel and white of egg, may possibly save the animal.

*Inflammation of the bowels* is a frequent disease in all these animals, but especially in horses and sheep, in the former of which it is usually called inflammatory colic, and in the latter dry braxy. It is marked by fever, violent pain in the belly, denoted by groaning, frequent changes of position, turning the head towards the part, and stamping, and the animal flinching when the belly is pressed, by obstinate costiveness, and the beast raising high its back. The disease is very dangerous and rapid in its progress, soon terminating in mortification, unless speedily arrested. For this purpose, the animal should be copiously bled, should have frequent clysters of gruel and Glauber's salt, and the belly should be repeatedly fomented. Internal medicines are useless till the fever subside, and then purgatives may be given by the mouth.

*Dysentery*, called body-founder in horses, and break-shaw in sheep, is a milder inflammatory affection of the bowels, distinguished by fever, a slimy discharge from the bowels, and scanty evacuations of hard excrement. Its chief causes are cold and moisture. The proper treatment is to bleed moderately, foment the belly, and give repeated drinks of gruel and Epsom salts, with clysters of the same, and afterwards to give balls of opium and ipecacuanha. Mucilaginous drink should be freely supplied.

*Inflammation of the kidney* occurs in horses, cattle, and sheep, but its symptoms are obscure. It may be suspected when there is heat about the flanks and loins, with a difficulty of making water, or bloody urine. It is commonly produced by calculous concretions in the kidneys, and is best relieved by bleeding, fomentations, plenty of mucilaginous drink, and a bran mash with nitre every night.

*Inflammation of the bladder* is uncommon. It is known by heat in the seat of that organ, with either incontinence or stoppage of urine, according as the body or neck of the bladder is affected. Bleeding, fomentations, repeated warm opiate clysters, and abstinence from drink, are the chief remedies.

*Farcy* is an inflammatory affection of the lymphatics, almost peculiar to the horse. It shews itself by hard knotted cords below the skin, chiefly about the head, neck, and limbs; by degrees the system becomes affected, the knots increase and burst, forming ill-conditioned ulcers, very difficult to heal. The disease now puts on another form, and is called

*Glanders.*—This is a constitutional affection, and might with propriety be placed among the cachectic diseases, were it not regarded as a modification of *farcy.* The most obvious symptom is a constant running from the nostrils of a glairy mucus, sometimes resembling matter, and in the later stages becoming bloody, and offensive. On examining the nostrils, they appear inflamed and ulcerated, and gradually the bones of the nose are affected, and become carious. The general system is much affected, and the horse falls into a state of hectic fever, and dies from debility and emaciation. The causes of glanders and farcy are uncertain, but they are both believed to be contagious. Though glanders is commonly connected with farcy, it sometimes occurs as a primary disease, or as the consequence of a severe cold. The remedies for these affections are both external and internal. Of the former, blisters, rowels, firing, the steam of hot water to the nostrils, and washing them with a solution of corrosive sublimate, are most recommended; while verdegris, mercury in the forms of calomel or sublimate, arsenic, and salt of iron, have been given internally with various success. Free air, and regular *draught* exercise, are also useful, and the drink should not be cold. Farcied or glandered horses should be kept by themselves.

*Sheep* are subject to two inflammatory affections of the skin, called *red-water* and *wild-fire.* In the former, vesicles containing a reddish watery fluid appear on the skin, and gradually burst and form a dark scab. It is most common in winter, and is said to be produced by cold. It is cured by opening the vesicles and washing them with infusion of tobacco, giving sulphur and nitre internally, and finally washing the skin with lime-water. Wild-fire is more inflammatory than the preceding, seldom forms vesicles, is supposed to be contagious, and appears in autumn. Giving repeated doses of Glauber's salt in the morning, and sulphur at night, and washing the affected parts with Goulard water, are recommended as the best treatment.

*Foot-rot* is a formidable inflammation of the sensible hoof, producing lameness, acute pain, suppuration and mortification, or loss of the hoof. It is caused by long standing in wet or marshy pastures or folds, and long journies in a wet country, and is supposed to be contagious. If discovered early before suppuration has taken place, it may in general be stopped by repeatedly plunging the foot into hot water, removing the sheep into a dry place, and giving purging salts. If suppuration has commenced, the sore must be laid open and washed, first with warm water and soap ley, and afterwards with muriatic acid or mercurial lotion, and regularly dressed, as directed under *Ulcers.*

*Black-leg,* or leg evil, is another serious and infectious affection of the foot or knee; producing swelling, pain, lameness, and dark-coloured blisters. The treatment consists in removing the wool, washing the limb with soap and water, opening the blisters, and dressing them with ointment of red precipitate, and defending them from the air.

### SECT. III. *Of Febrile Eruptions in Domestic Animals.*

The only febrile eruption commonly known in Britain is the *cow-pox,* and this is generally a very mild disease, shewing itself by vesicular pustules on the teats of cows. The fever that accompanies it is in general very slight, but the teats are sometimes much ulcerated. It is communicated from one cow to another by the hands of the milkers, and probably this is the only way in which it is propagated. The only remedies necessary are a gentle purgative at the beginning and end of the disease, and dressing the teats when very sore with simple ointment.

*Grease* in horses naturally follows cow-pox, as it appears, from the observations of Jenner, and the experiments of Loy, that the former is capable of producing the latter. Grease, or greasy heels, is an affection peculiar to horses, among whom it is very common. It is often only local, consisting of a swelling and inflamed state of the heel, followed by an oozing through the skin of a yellowish, greasy, offensive matter. It renders the horse partially lame, and exercise appears for the time to aggravate the disease. The hair gradually falls off, and the skin becomes discoloured and puffy; ulcers form about the heels and spread, and last the bones grow carious. In general grease, the horse is irritable, weak, and restless, the heels are very tender, and bleed on being touched. Fever may precede or accompany this last form, and it is only then that the disease is capable of producing cow-pox. Weak phlegmatic horses, with fleshy legs and white feet, are most liable to grease, and it is easily excited by standing long idle in the stable, want of cleanliness and rubbing, and sudden transitions from cold to heat, and the contrary. It is prevented by avoiding these causes, and especially by free exercise in the pasture. The treatment must vary with the stage and nature of the disease; but in all cases the hair must be cut short, and the parts must be gently washed with salt and water; the horse must be kept dry, regularly but moderately exercised, and fed on green or succulent food, and if confined to the stable should stand without litter all day. At the beginning of local grease, the best applications are oil of turpentine mixed with olive oil, fomentations, and poultices, and if ulcers appear they must be treated as directed for indolent, spongy, or ill-conditioned sores, according to circumstances.

If there be much swelling, with heat, topical bleeding will be proper; but if the horse be plethoric, he must be bled and purged. Diuretics are required in every stage but the last, and then recourse must be had to tonics, stimulants, and narcotics.

### SECT. IV. *Of Painful Diseases in Domestic Animals.*

*Rheumatism* is the only painful disease which can be distinguished in these animals, and that occasionally attacks the horse. It may be either acute or chronic, but it is not easy to decide which is present. This disease may be suspected when the horse is lame without any obvious defect in the limbs, when the lameness appears to follow long or sudden exposure to cold, and goes off during continued exercise, and when the limb, on examination, is found to be swelled.—Moderate bleeding and purging, if the horse be plethoric or feverish, alternate fomentations to the limb, and friction, with stimulating ointments or blisters, with a warm mash with nitre at night, and, if the disease continue, a ball of opium and calomel, and regular exercise in dry weather, form the proper treatment.

### SECT. V. *Of Spasmodic Diseases in Domestic Animals.*

These, as in man, are either acute or chronic. To the former head belong Tetanus, Hydrophobia, Convulsions, and Colic;—to the latter Purging and String-halt.

*Tetanus*, or locked-jaw, is not uncommon in the horse, and is marked by spasmodic contractions of the muscles, first of the neck, and then of the whole body, preceded by elevated head, pricked-up ears, out-stretched neck, cocked tail, fixed eyes, snorting, and an appearance of great terror. It commonly lasts for three or four days, and then, in most cases, proves fatal, either from exhaustion, accumulation of blood in the head, or inflammation and mortification of some internal organ. It is usually the consequence of a punctured or lacerated wound, in which a nerve or tendon has been pricked or partially divided; but it may arise from other causes, especially sudden exposure to cold when overheated. A cure is always doubtful; but it may be attempted by bleeding, strong purgative clysters, followed by narcotic clysters, dashing cold water over the body, then drying it thoroughly, and rubbing it with anodyne balsam.

*Hydrophobia*, or canine madness, may appear in any of these animals from the bite of a mad dog, but is most common in this last animal. Its approach is gradual, shewing itself first in a failure or nicety of appetite, irritability, and a disposition to quarrel with other dogs, and howling, but not *barking* or crying, even when struck. Then succeeds a total loss of appetite, while thirst is urgent, and the dog frequently *laps* water, though he swallows none. When the disease is confirmed, the mouth is dry or slimy, but not in general foaming; the dog appears fearless of danger or punishment, and bites every animal that comes in his way. The disease generally proves fatal, from inanition or convulsion, in about ten days from its first appearance. It may arise spontaneously in the dog, from long exposure to great heat, with want of water, or from being much irritated, or long pursued and persecuted, but it is generally the consequence of a rabid bite. It may appear after such a bite, at any time, from ten days to eight months. Cases of canine madness are generally hopeless, and perhaps the only treatment likely to succeed is, to take the animal, after muzzling him, to the sea, or to a river, and make him swim after a boat till nearly exhausted. If it can be ascertained in time that the animal has been bitten by a mad dog, the disease may be prevented by cutting out the bitten part, and firing the wound.

*Convulsions*, called *staggers* in sheep, shewn by the animal's falling down and rolling about, or twitching its limbs, are not uncommon in sheep and dogs. The disease is seldom fatal, and may arise from improper diet, worms, terror, or fulness of blood. It is removed by bleeding, the cold bath, and change of diet.

*Colic* is marked by pain in the belly, without fever and not increased by pressure, and by obstinate costiveness. It is produced by much the same causes as in man, but is more dangerous in these animals, as it is very apt to terminate in inflammation.—Hence bleeding is proper early, and to this must be added purgative clysters, fomentations to the belly, and balls of opium and calomel till the spasm be relieved, and then purgative drenches.

*Purging*, or scouring, is a very common complaint, and is marked by most of the varieties, and produced by much the same causes, as what have been mentioned under MEDICINE. It is seldom dangerous, except in very debilitated animals, and when long protracted; and, indeed, it is often salutary, and should not be too soon checked, especially in sheep. Except in the cases just mentioned, it is proper to begin by giving emollient drenches and clysters, keep the animal warm, and change the diet to one more solid and substantial. If this prove insufficient, a ball of rhubarb and laudanum may be given at night, and prepared chalk should be added to the drenches. More obstinate cases require the use of opiate clysters and internal astringents.

*Pinning*, or pinding, an adhesion of the tail to the fundament, preventing evacuation, is a consequence of purging in lambs which have not been docked. The most effectual remedy is to cut off the lower part of the tail, and stop the bleeding by firing; but if the accident be discovered early, it is sufficient to disengage the tail and anoint the parts with hog's lard.

*String-halt*, or click-spavin, is a spasmodic affection of the hind-quarters in the horse, producing a jerk of the legs, when first set in motion. It is supposed to resemble *chorea* in children, and is relieved by the warm-bath, with friction of the limb with anodyne balsam, and a long run in an open pasture.

### SECT. VI. *Of Lethargy in Domestic Animals.*

Horses are subject to a disease called *staggers*, which nearly resembles apoplexy in its previous and concomitant symptoms and causes, and requires the same treatment. During the fit, the animal is sometimes a little convulsed before falling into a state of coma. If not soon relieved, the fit commonly proves fatal, and seldom terminates in palsy. Plethoric horses that are high fed and little worked, are most liable to staggers, especially when suddenly stimulated to great exertion. Copious bleeding, or even tying the carotid arteries, purging, low diet, and rest, are the chief remedies for removing a fit, and a relapse is prevented by temperance, exercise, and free air.

### SECT. VII. *Of General Inabilities in Domestic Animals.*

*Palsy* is not very common in these animals, and is generally the consequence of some debilitating disease. What is called *thwarter-ill* in sheep is supposed by some to be a paralytic affection; but it is not easy, from the descriptions that have been given of it, to decide the point. If palsy occur in a plethoric state of the system, it must be treated by bleeding and purging; but when it is the consequence of debility, strengthening medicines, generous diet, and stimulating liniments to the affected parts are required.

*Indigestion* is not uncommon in horses and dogs that are pampered with abundant food, and not allowed sufficient exercise. It is marked by the usual symptoms of deficient or depraved appetite, flatulence, pain in the stomach, sickness and vomiting in the dog, heaviness and costiveness. It is cured by purgatives, and, in the dog, by an emetic, change of diet, free air, gradually increased exercise, and tonic medicines.

### SECT. VIII. *Of Cachectic Diseases in Domestic Animals.*

Many of the diseases classed under this head in the preceding treatise are occasionally observed in domestic animals, especially Consumption, Jaundice, Diabetes, and Dropsy, and to these may be added the Rot in sheep.

*Consumption* of the lungs may arise in any of these animals, as a consequence of pleurisy or severe catarrh; but is scarcely observed, in its true form, as originating in a tuberculated state of the lungs, except in the sheep, in whom it has been called *pulmonic rot*, and has been confounded with other complaints, under the general name of rot. It is marked by short breathing, easily hurried by exertion, cough, with expectoration of thick matter, and sometimes more solid substances, offensive breath, hectic fever, and emaciation. It generally proves fatal; but, in a few cases, after the cough and spitting have continued for some time, the animal recovers. It probably occurs only in those sheep who have originally tubercles in the lungs, and is excited by inflammation and suppuration of those tubercles, generally in consequence of exposure to cold and moisture. Medical aid is almost hopeless; and all that can be done is to remove the sheep to a dry and warm situation, and support their strength by plenty of good wholesome food.

*Jaundice* is not a common disease in any of these animals, least of all in the horse and sheep. It is distinguished by a yellowness of the white of the eye, high-coloured urine, costive and clayey evacuations from the bowels, and signs of indigestion. It is seldom dangerous, though it is said that horses have died of it in two or three days. It arises from an obstruction of the pipes that convey the bile from the liver to the bowels; and, except in the horse, who has no gall-bladder, that obstruction is caused by concretions formed in the gall-bladder stopping up those pipes. For the cure of this disease, purgatives containing calomel, emetics for all but the horse, and repeated fomentations to the pit of the stomach, are the chief remedies.

*Diabetes*, or profuse staling, sometimes occurs in horses and cattle. The principal symptoms are, an increased discharge of urine, exceeding the quantity of liquid drunk, but the chemical nature of which has not been correctly ascertained; great thirst; a variable appetite; and latterly great weakness and emaciation. It is a dangerous disease, and its causes are very obscure; but, as in man, it appears to originate in a depraved state of the digestive organs. The cure must be attempted by a moderate bleeding, giving the most nourishing food, as baked wheat and wheaten bread, but not animal food as recommended by some theoretical writers, and astringent medicines, with an opiate ball every night, attending, at the same time, to the state of the bowels to avoid costiveness.

*Dropsy*, in most of its varieties of situation, in the cellular membrane, the head, the chest, and the belly, is frequently observed in the domestic animals. Dropsy of the cellular membrane, or *anasarca*, called by farriers *water farcy*, is not common as a primary disease, but usually accompanies internal dropsy. It most frequently takes place in the legs, which are swelled, feel cold to the touch, and pit when pressed with the finger. Anasarca, like the other dropsies, is attended with great general weakness, and the urine is scanty and high-coloured. Dropsy of the *head*, properly so called, is very uncommon; but sheep are subject to a disease called *sturdy* or *turnsick*, caused by the presence of a watery bladder, which is an animalcule or *hydatid*, between the skull and the brain, and which, pressing on the latter, produces several distressing symptoms, and, if not removed, generally destroys the sheep. The animal in which that parasite forms at first appears dull and stupid, separates from the flock, often starts, and seems giddy and bewildered. As the hydatid enlarges, the sheep is more affected, and occasionally turns round several times together, and sometimes falls down. On examining the head, one part of the skull will be found softer than the rest, and below that the worm is seated. Young sheep, or hogs of a year or year and a-half, are most liable to the disease. Water in the *chest* seldom occurs, even in the horse. It may be suspected, when the animal has a difficulty of breathing, increased on lying down or after exercise, when signs of general dropsy appear, and when, on striking the chest some hours after drinking, a fluctuation is perceived in that cavity. This species is probably incurable. Dropsy of the *belly* is the most common, and is easily known by swelling and fluctuation in that part, accompanied by the other signs of dropsy. In general it is at first easily removed by proper remedies, or, if the water accumulate to a great extent, it may be drawn off by tapping; though, in that case, the disease is only relieved for a time, soon returns, and eventually proves fatal. Old and debilitated animals are the chief subjects of proper dropsy, but the causes are more obscure in the inferior animals than in man. The treatment most likely to succeed in common dropsy is to give diuretic medicines, allowing plenty of emollient drink to promote their operation, giving the animal nourishing diet, with an occasional purge, free air, and moderate exercise; and in anasarca, frequent friction over the swelled part. In obstinate cases a course of mercury in addition to the diuretics is required. The cure of *sturdy* is effected by an operation for removing the hydatid or evacuating the water it contains. For the first, the scalp is cut and raised from the skull, a circular piece of the latter is cut out, and the hydatid is extracted as whole as possible with a hook. The other purpose is effected by a very simple but ingenious operation, discovered, it is understood, by the Ettrick shepherd; namely, thrusting a pointed wire up the nostrils and through the brain, till it reach the seat of the complaint, or come in contact with the skull. We are assured that this method commonly succeeds.

*Rot* is a general name given to several diseases that affect the sheep. Three of them have been already noticed, and two others remain to be considered. One of them seems to be originally an affection of the liver, similar to chronic inflammation of that organ, and is called *hepatic rot*. The symptoms of this species are not clearly marked by writers on the subject; but it appears that there is some degree of fever, with signs of biliary affection, and after death the liver is found diseased, and having, in various parts, hollows containing the worm called *fluke* (*fasciala hepatica.*) *General rot*, which more properly belongs to the present head, is distinguished by softness and flabbiness of the flesh, and a greater wasting than in hepatic rot, with a peculiar crackling of the skin when handled, paleness of the skin, face, gums, and tongue. In the more advanced stage, the skin below the wool appears speckled with black and yellow, the eyes look dull like those of a dead fish, and have a peculiar appearance at their inner corner; the breath becomes offensive, the gums spongy, the teeth and horns loose, the wool torn and ragged, a scouring comes on, the animal is more and more emaciated, and either dies from debility or falls into incurable dropsy. In this disease, as in the last, the liver is found much diseased, but with different appearances. The liver is pale, soft, spotted, and semi-transparent at the edge. The causes of hepatic rot are obscure; but it is supposed that the flukes generated or hatched in the liver form the principal exciting cause. General rot is the consequence of unwholesome grass produced and eaten on marshy ground, and partly, perhaps, of the tainted air which sheep, in such situations, are compelled to breathe. This last species is now thought to be a kind of scurvy. In both cases, the first object in the treatment is to remove the sheep to a dry upland pasture; and this change alone, in the early stage of general rot, is commonly sufficient to effect a cure. After removal the sheep should be vomited and purged; and if there be any reason to suspect that the liver is affected, a course of mercury will be proper. Pure air, gentle exercise, and wholesome food will contribute much to the recovery of the sheep.

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**MEDICIS, LORENZO DE**, styled the *Great*, and the *Father of Learning*, was born at Florence in 1448. In early life he indicated talents of no ordinary kind and, at the same time enjoyed every desirable assistance in the acquisition of knowledge. After a visit to Italy, with the view of being initiated into political life, he, in 1469, married a daughter of the noble family of the Orsini; and in the same year he succeeded to the power and authority of his father, the celebrated Piero de Medicis. Lorenzo, together with his brother Giuliano, now became obnoxious in the eyes of Pope Sixtus IV. owing to their opposition of measures detrimental to the petty princes of Italy; so that on this account Cardinal Riario and the archbishop of Pisa were appointed to assassinate them at the cathedral, on Sunday, April 26, 1478. In the execution of this diabolical purpose, the assassins were courageously opposed by the magistrates and people, who, infuriated at witnessing Giuliano's destruction, and Lorenzo himself besmeared with blood, immediately hung the archbishop, in his pontifical robes, from one of the windows; while *Medici, Medici,—down with their enemies!* re-echoed throughout Florence. Lorenzo being safely conveyed home, magnanimously endeavoured to appease the rage of the populace, which was indiscriminately directed at the conspirators; but none of the guilty who were found escaped an ignominious death. Lorenzo, who had been previously deprived of the office of treasurer of the Roman see, was now excommunicated by the enraged pope; and another unsuccessful attempt was made upon his life on the festival of the Ascension in 1481. After the death of Sixtus IV. however, he was freed of an incorrigible foe, and was happy to find a friend in Pope Innocent VIII.

As head of the Florentine republic, Lorenzo rendered himself eminently popular, not only by his great political wisdom, but by his extraordinary attainments in literature and the fine arts, of both of which he was truly a munificent patron.

The domestic felicity of Lorenzo de Medicis was unhappily clouded by the decease of his lady in 1488; and he himself was cut off in 1492, by means of a violent attack of the gout,—a disorder to which he had previously been subject for years. The celebrated Mr Roscoe has done ample justice to the memory of this remarkable man. "Of the various occupations," says he, "in which Lorenzo engaged, there is not one in which he was not eminently successful; but he was more particularly distinguished in those which justly hold the first rank in human estimation. On all sides he touched the extremes of human character, and the powers of his mind were only bounded by that impenetrable circle which prescribes the limits of human nature."

**MEDINA**, a town of Arabia Felix, situated in a sandy plain, and remarkable as the burial-place of Mahomet, is walled round, and contains a spacious mosque, in the corner of which is the tomb of Mahomet, inclosed with curtains, and lighted by a variety of lamps. This town derived its present name from the circumstance of Mahomet having taken refuge in it when pursued by the Koreischites. The Wehabites were as outrageous at Medina in 1803 as they had previously been at Mecca.

**MEDITERRANEAN**, a vast inland sea extending between the continents of Africa and Europe into Asia, as far as the Euxine sea and the Palus Mæotis. It communicates with the Atlantic by the straits of Gibraltar, and with the Black sea by the strait of Galipoli, the sea of Marmora, and the straits of Constantinople. The Mediterranean exceeds 2000 miles in length from east to west, and its average breadth is between 400 and 500 miles. It has very small, if any, tides; but one constant current sets in from the Atlantic, and another strong one from the Bosphorus. Of the different divisions, that to the west of Italy is named the Ligustic or Tuscan sea, that near Venice is called the Adriatic, and the Ionic or Ægian sea of the ancients is towards Greece. The most considerable islands of the Mediterranean are Majorca, Corsica, Sardinia, Sicily, Candia, and Cyprus. Great Britain derives vast advantage by means of the trade carried on through the Mediterranean sea.

**MEDIUM**, the middle term of three numbers in arithmetical or geometrical proportion. But, in a philosophical sense, the term denotes that space or region through which a body in motion passes to any point; thus, air is the medium wherein bodies move near our earth; glass is a medium of light, &c. According to Sir Isaac Newton, the subtile or etherial medium is universal, and incomparably more rare, elastic, active, and subtile than common air; and is therefore capable of passing freely through the pores and interstices of all other mediums, and of diffusing itself through every part of the creation; and by this medium he supposes most of the grand phenomena of nature are effected. The density, in the parts of the medium by which the motion of bodies is retarded is called the resistance of the medium; and this, together with the force of gravity, occasions the interval of the motion of projectiles.

**MEDLAR**, MESPHILUS, a genus of plants belonging to the Icosandria class. See BOTANY.

**MEDUSA**, one of the three Gorgons, daughter of Phorcys and Ceto, and celebrated for her personal charms. Her beautiful locks were changed into snakes by Minerva, and she herself was killed by Perseus.

**MEDUSA**, a genus of Zoophytes of the Order *Radiata*. See HELMINTHOLOGY.

**MEDWAY**, a river of England which rises in Ashdown forest in Sussex. Its chief course being to the county of Kent, it flows by Tunbridge to Maidstone; is thence navigable to Rochester; and at Chatham it is a station for the royal navy. It afterwards is divided into two branches which flow to the German ocean; the northern one entering at Sheerness, and the eastern, called the East Swale, entering at Whitestable. This river abounds in fish of various kinds; it is the medium of considerable trade, and is well fortified by the castle of Sheerness.

**MEGARA**, the celebrated capital of Megaris in Greece, but now a humble village retaining its ancient name. It was situated in a vale, on each side of which was an acropolis or citadel; and it contained, besides, a temple of Ceres and other noble edifices, a splendid aqueduct, twelve statues ascribed to Praxiteles, and a statue of Diana. The port was called *Nisæa*, from Nisus, son of Pandion, the second who obtained the Megaris for his portion when the kingdom of Athens was divided into four portions. This city was for years engaged in wars with the Corinthians and Athenians, and was the only one of the Greek cities that did not re-flourish under Adrian, the common benefactor.

MEKRAN, or MECRAN, a mountainous province of Persia, extending from Cape Iask to the frontiers of Scind, and bounded on the south by the Indian ocean, on the north by Seistan and Arokaje, on the east by Scind, and on the west by Kerman, is divided by a range of mountains into two parts, Balouchistan and Luss. The former is again subdivided into seven districts, *Ihalawan*, *Sarawan*, *Cutch Gandava*, *Anund Dejel*, *Shal*, and *Mustung*; and *Zuhree*, which latter is the most civilized of the whole province. Luss is surrounded with mountains, has two rivers, the Wudd and Pooralee, and is very fruitful in grain. The inhabitants, who are chiefly fishers, have no other way of procuring water but by making holes in the earth, which, after a supply is procured, must be filled up, otherwise the water, it is said, becomes salt. The overflowing of the Heermund occasions the fertility of this district.

The chief rivers of Mekran are the Neam Khor or salt river, the Cajoo, and the Bunpoor, which is augmented by another river, and extends from east to west. This province is occupied by different tribes, but the Balouches are the most numerous. The whole population is supposed to be about 25,000. The mountains are productive of lead, iron, gold, and silver, and other metals. Kinneir's *Geog. Mem. of Persia.*

MELA, POMPONIUS, an ancient Latin writer, who was a native of Bætica in Spain, and flourished during the reign of the emperor Claudius. A quarto edition of his celebrated work on Cosmography, *De situ Orbis*, was published by Isaac Vossius, with notes, in 1658. The edition of Gronovius was illustrated with medals; and to the last edition is appended *De Geographia*, in five books, of which Fabricius is supposed to be the author.

MELANCTHON, PHILIP, an eminent reformer, born at Bretten in Saxony in 1497, and died at Wittemberg in 1560. He evinced extraordinary talents at a very early age; and such were his classical and literary attainments in his fourteenth year, that he was then respectable as a tutor. After receiving his degree of bachelor of arts at the college of Pfortsheim in 1511, he removed to that of Tubingen, where he became lecturer on the Latin classics, and was created doctor of philosophy before the completion of his seventeenth year. In 1518, he obtained the professorship of the Greek language at the university of Wittemberg, in which situation he was greatly esteemed as a lecturer; and his celebrity was likewise enhanced by his new system of instruction called the *Phillippic method*, and afterwards introduced into all the public institutions. He now contracted an intimacy with Luther, and zealously interested himself in the cause of reform. The publication of his Lectures on the Epistle to the Romans, in 1520, was followed by that of the "Theological Common Places,"—a justly celebrated work, the rapid circulation of which was effectually checked by the Inquisition. Melancthon was next associated with Luther in digesting a system of laws respecting church government, which was promulgated through the dominions of the elector of Saxony. Having accompanied the elector to the diet at Spire in 1529, he was in the following year employed by the Protestant princes to draw up a Confession of Faith, which was denominated the *Confession of Augsburg*, because at the diet held in that place it was delivered to the emperor. This admirable creed, and the able yet dispassionate manner in which he, at various conferences, defended the points contained in it, reflected great honour on Melancthon, who was now invited to France by Francis I., and to England by Henry VIII., but detained by the elector of Saxony. He assisted at the conferences at Ratisbon in 1541, as well as at seven conferences on the subject of the interim of Charles V. in 1548. The academies and churches of Misnia were arranged by him in 1553; in the following year he was engaged in a conference at Nuremburg; and indeed the anxiety and fatigue to which he was constantly subjected, in promoting the interests of religion, at length terminated his existence, in the 63d year of his age. One of his several reasons for looking upon death as a happiness, written several days prior to his decease, was, that it "delivered him from theological persecutions." This great man was not less remarkable for his amiable disposition than for his literary attainments. Indeed the mildness of his temper was such, that Luther, as well as others, construed it into lukewarmness. His piety, however, was unfeigned, his charity unbounded, and his investigations were uniformly directed in the pursuit of truth. A correct edition of his works appeared at Wittemberg in 1601, in four volumes folio. Mosheim's *Eccles. Hist.* Vol. IV.; Cox's *Life of Melancthon.*

MELCHISEDEC, or MELCHIZIDEK, is in Scripture represented as king of Salem and priest of the Most High, Gen. xiv. 17, &c. It is said he was a figure of Jesus Christ, who is, as St Paul declares, "a priest for ever after the order of Melchisedec," that is, raised up to appear for ever in the heavens, and there officiate as a priest. Various opinions have been suggested respecting Melchisedec. The Salem, of which he was king, is supposed by St Jerome to have been a city of that name near Scythopolis, where a magnificent palace is said to have stood; and others imagine, that this Salem is the same as the Salem alluded to in the gospel of St John, chap. iii. 23. A sect was founded in the third century by one Theodotus, who affirmed that Melchisedec was a heavenly power, and superior to Jesus Christ.

MELCHITES, in ecclesiastical history, is a denomination of Christians in Syria, Egypt, and the Levant, who, though not Greeks, adopted the doctrine and discipline of the Greek church, and were governed by a patriarch.

MELCOMB REGIS, a borough town of Dorsetshire, united to Weymouth as a port, corporation, and market town; is situated on the north side of an arm of the sea; and is regular, and well built.

It contains a handsome church and a town-hall; likewise a convenient bridge is erected across the river Weymouth. The corporation consists of a mayor, recorder, two bailiffs, and a number of aldermen and burgesses.

MELEAGRIS, the turkey, a genus of birds of the order Gallinæ. See ORNITHOLOGY.

MELIANTHUS, honey-flower, a genus of plants belonging to the Didynamia class.

MELICA, rope-grass, a genus of plants belonging to the Triandria class.

MELISSA, baum, a genus of plants belonging to the Didynamia class.

MELITE, in ancient geography, an island in the Mediterranean, which is supposed to be the place where St Paul was shipwrecked in his voyage to Rome. Mr Bryant maintains, that the writer of the Acts of the Apostles refers to an Illyrian island in the Adriatic sea as the actual place where this shipwreck occurred.

MELKSHAM, a market town of Wiltshire, seated on the river Avon, and said to have been a place of some importance in ancient times. It is handsomely built, though the streets are narrow and irregular, and contains a spacious parish church, and different dissenting meeting-houses. Melksham is celebrated for the manufacture of fine cloths and kersimeres, and the intercourse with Bath and Bristol is effected by means of the Wilts and Berkshire canal. The population is estimated at 4000.

MELODY, in music, the pleasurable effect of different sounds, disposed in succession, according to the laws of rhythm and modulation. See MUSIC.

MELOE, a genus of insects of the order Coleoptera.

MELON, *Cucumis melo,* a genus of plants belonging to the Monœcia class. For an account of the culture of the melon, see GARDENING.

MELOS, ancient geography, one of the Grecian islands, situated between Crete and the Peloponnesus. It was peopled by a Lacedemonian colony 1116 years before the Christian era, and enjoyed independence for upwards of 700 years antecedent to the Peloponnesian war, when it was doomed to destruction by the Athenians, who possessed themselves of it until repulsed by Lysander. Melos, together with the other islands of the Ægian sea, was afterwards reduced to a Roman province.

MELPOMENE, the tragic muse, and the daughter of Jupiter Mnemosyne. She is commonly represented as young and of a grave aspect, with splendid garments, a dagger in one hand, and in the other a sceptre and crown. Horace addresses her as the patroness of lyric poetry.

MELROSE, a borough town of Roxburghshire in Scotland, seated on the river Tweed, is about a mile in length, and chiefly remarkable for the celebrated abbey of David I. founded in 1136, some remains of which are still to be seen, particularly the church, part of which is devoted to divine service. These remains are a striking evidence of the original magnificence of the abbey. It is said that Alexander II. was buried under the great altar.

MELTON, MOUBRAY, a market town of Leicestershire, seated on the river Eye, contains a spacious church, together with a free school; and, besides the weekly market for cattle, it has three annual fairs. The population in 1811 was stated at 2141.

MELVILLE, LORD VISCOUNT, Baron Dunira, Right Honourable Henry Dundas, a younger son of the Lord President Dundas by a second marriage, and also brother to the Lord President, the successor of the former in that office, was born 1740. They were the descendants of a younger branch of the Dundasses of Dundas, a family of considerable distinction in West Lothian in Scotland. Having in early life been educated at the High school of Edinburgh, and, under the superintendance of a private tutor, Mr Dundas afterwards prosecuted the study of law in the university of that city; and as several of his immediate ancestors had attained the highest honours belonging to that profession, the bar presented itself to him as the most proper path for the exercise of his talents and ambition. Soon after he had completed his academical studies, he was, in 1763, admitted a member of the Faculty of Advocates in Scotland, and in a short time obtained the appointment of Solicitor-general, which was afterwards followed by that of his Majesty's advocate, when Sir James Montgomery was advanced to the office of Lord Chief Baron in 1775. During several sessions of Parliament he represented the county of Edinburgh; but having then engaged himself in objects of a higher and more noble ambition, he withdrew himself entirely from the profession of the law. He afterwards represented the city, in which honourable office he continued till he was advanced to the peerage in 1803.

His political career commenced under the administration of Lord North, at a time when the difficulties of an embarrassed and feeble ministry held out the most flattering prospects to the ambition of those who strove to displace them. During the struggles of the contending parties, Mr Dundas's ambition was to make himself completely master of some of the grand branches of national business, and especially of the British affairs in India; so that, after several contests and changes of the ministry, when an efficient administration was at last established under Mr Pitt, Mr Dundas was considered peculiarly qualified for taking a leading and active share in the management of public affairs, and became his steady friend and coadjutor. Eminently qualified, by his great talents, to be useful to his country in the highest departments of government, he was not only valued as a friend, but respected and feared as an opponent. Distinguished by his diligence in business, as well as by his penetration and sagacity, even his opponents could not fail to perceive that he was destined to occupy no mean place under any administration. To Mr Pitt, therefore, his aid and assistance must have been invaluable; and certain it is, that, by his genius and talents, he contributed in no small degree to bring over to his interests most of the great leading members of the East India company, at a most important period of parliamentary contest, in consequence of which he was elevated to the appointments of treasurer of the navy and president of the board of control of the East India company, with a seat in the cabinet council. His arrangements respecting the payment of seamen's wages were soon found to be peculiarly favourable to the royal service; and in his knowledge of Indian affairs, of the state of the company's capital, pecuniary, territorial, and commercial, and of the arrangements necessary to maintain the government of that vast territory, and to render it an actual addition to the political power and strength of the British empire, he stood altogether unrivalled. In the House of Commons his eloquence was always powerful, clear in argument, rich in common sense, in political sagacity, in original knowledge of expediency, and in every thing connected with the principles of government and state affairs. In addition to his other offices, therefore, the importance of his services to the administration, of which he was so zealous and powerful a supporter, procured him the seals of secretary of state.

With Mr Dundas, likewise, chiefly originated those admirable measures for the formation of fencible corps, supplementary militia, provisional cavalry, and volunteer companies, and all those powerful means of internal defence against insurrection and invasion which have proved so beneficial to the public peace. Intrusted almost solely with the direction of public affairs in Scotland, he was ever zealous in promoting the interest of all classes of the community, so that there was never known at any period to be less of discontent than during his administration. That patriotic and benevolent scheme for restoring the forfeited estates, so eminently calculated to soothe the minds of many great and noble families in Scotland, must likewise be regarded as one of his wisest and most commendable measures; and experience has shewn, that nothing could be better adapted for putting an end effectually to that civil discord and spirit of rebellion which had so long and so often disturbed the peace and tranquillity of this kingdom.

In regard to the management of public business, Mr Dundas was capable of the most laborious application as well as of the most surprising discernment, arrangement, and dispatch; so that, by this means, what might be toilsome to others, was easy and pleasant to him. That he had no faults, that he possessed every talent, and was spotless in virtue, is what never can be said of him or any other man; but that he was eminent in all respects compared with many able contemporary politicians, is assuredly not to be disputed. That Scotland improved under his administration cannot be denied, although he never proposed to prosecute what have been termed measures of reform; and it must indeed be allowed, that to improve society is altogether impracticable without first improving the elements of which it is composed, and this can only be effected by making men morally wiser and more virtuous, since the administration of every government must in some degree correspond with the characters and intelligence of the people themselves.

Mr. Dundas first married Miss Rennie, by whom he had one son, Robert, (now Lord Viscount Melville,) and three daughters; and next the sister of the late much lamented Lord Hopetoun, by whom he has left no issue. In 1805 he was impeached before the House of Commons, for transgressing against the provisions of the bill for regulating the office of treasurer of the navy, and, after a tedious trial, was honourably acquitted of all that had been laid to his charge. How far party zeal operated upon this occasion posterity will judge; but certain it is, that he is not the only individual, among the great and distinguished benefactors of their country and of mankind, who have suffered for crimes which they never committed, and which, indeed, they utterly abhorred. Mr Whitbread, who acted the most conspicuous part in this trial, and was one of the great leaders of the opposition, had the candour to declare, in his speech before the House of Commons, that "as to personal political purity, Lord Melville was untainted."—"A love of money," said he, "for its own sake, was never imputed to him by me or any man." On investigation it was found, that out of upwards of a hundred and thirty-four millions Sterling which had passed through his hands as treasurer of the navy, not one shilling was lost to the public; nor did it appear that, personally, he ever derived any profit or advantage whatever from the use of the public money. Regarding the character of this illustrious statesman, the British empire, during the brilliant period of its history for 28 years, under his administration and that of Mr Pitt, will enable the reader to form the most accurate judgment and the best comment.

His lordship having been requested to attend the funeral of his excellent and much respected friend, President Blair, in Edinburgh, had come to town for that purpose, on the evening previous to the interment, which was to take place on the 2d of June 1811, and was found dead in his bed, at the house of his nephew and son-in-law, the Lord Chief Baron, on the following morning. Having been in the habit of rising at an early hour, and not appearing at the usual time, his servant went into his room at eight, and calling him without receiving any answer, opened the curtains of his bed, when, to his utter surprise, he perceived his lordship with his head resting on one arm and the other extended on the bed, but without the smallest signs of life. It is supposed that an ossification of the heart, an incurable disease, had been the cause of this sad catastrophe, and that his death had been accelerated by the very unexpected loss of his much valued friend President Blair, by which he was deeply affected, and at whose funeral he proposed to attend the following day. To several of his friends, indeed, he had stated his apprehension that to him this would be a trying scene. On the preceding evening he had been employed in making some arrangements relative to the family of the Lord President, and, as their kind friend, had written a letter to Mr Percival, chancellor of the Exchequer, recommending them to his attention. Thus were the last moments of a long life devoted to the duties of disinterested friendship and benevolence. His lordship was upwards of seventy years of age, and died on the birth-day of his friend Mr Pitt. From a feeling of public gratitude for his eminent services as a statesman, a noble monument has been erected to his memory in his native city.

**MELVILLE, Andrew**, one of the most eminent successors of John Knox, was a native of Forfarshire in Scotland, and born in 1545. In consequence of the death of his father, he was in his second year taken under the care of his eldest brother, who bestowed upon him a most liberal education. After completing an academical course at St Andrews, he removed to France for the prosecution of his studies, particularly that of civil law. From France he went to Geneva, where he studied theology and succeeded to the chair of humanity. Returning to Scotland in 1574, he became principal of the university of Glasgow, and he rendered many essential services for the advancement of learning. About this period also appeared at Basil his poetical translation of the Song of Moses, &c. At Geneva he had imbibed a decided partiality for Presbyterianism, which, in his own country, he was now desirous to see substituted for the system of church government there prevalent; and being admitted a member of the General Assembly in 1575, he took an active part in preparing a scheme of ecclesiastical administration, which was unanimously approved of in 1578, and has since that period continued the standard of Presbyterian church government. Amongst other arrangements for improving the seminaries of education, Mr Melville, in conjunction with others, succeeded in converting the three colleges of St Andrews into a school of divinity in 1579; and he himself was by the voice of his country called to the charge of this institution, which, for upwards of twenty years, prospered under his fostering care. In addition to his arduous duties as principal and professor of divinity, he, during the first few years of his residence at St Andrews, performed the clerical duties of the parish. But the determined freedom with which he, from the pulpit, opposed every species of vice, rendered him obnoxious to the resentment of certain leading men; and, to avoid impending danger, he was now, for a short period, obliged to remove to England, after which he returned to his office at St Andrews, which, however, he was again compelled to quit for a time, owing to his being concerned in the excommunication of Archbishop Adamson by the synod of Fife.

The act of Parliament of 1592, ratifying the government of the church by general assemblies, presbyteries, and kirk sessions, was not only a source of much satisfaction to Mr Melville, but has to the present day been justly viewed as the legal foundation of Presbyterian church government. Subsequently to a tumult at Edinburgh in 1596, the zeal and influence of Mr Melville were essentially called forth, from time to time, in counteracting a proposed change in the constitution of the church; and he was a member of the assembly at Burntisland in 1601, at which the king renewed engagements as a covenanter, and suggested the propriety of revising the translation of the Scriptures. But Mr Melville's boldness and freedom of speech, regarding the conduct of ministers, occasioned his confinement within the precincts of the college, until the accession of King James to the English throne, when the indulgence granted him, of liberty to travel six miles around St Andrews, drew from him three poems of a congratulatory nature. Mr Melville's intrepid zeal in behalf of the rights of the General Assembly, together with his opposition of Episcopacy, proved offensive to the sovereign; and himself and seven other ministers of Fife were summoned to London to treat of the affairs of the church. On this occasion a powerful disputation was maintained before the king, nobles, and dignitaries of the church; and being all summoned to attend divine service at the royal chapel on Michaelmas day, Mr Melville was rash enough to write an epigram on the apparent resemblance of the service to that of the Romish church, in return for which he was charged with *scandalum magnatum*; his office was declared vacant, and he was committed to the Tower, where, for the first year, he was treated with harshness and denied all communication. This confinement, which lasted four years, proved unfavourable to his health, and he at length sunk under the weight of years at the advanced age of 72.

The talents and erudition of Mr Melville, in conjunction with his resolute and acute turn of mind, peculiarly qualified him for the serious duties and difficulties to which he was destined. His great influence was maintained, not by intrigue or insinuation, but by the legitimate efforts of a powerful genius. In piety, benevolence, and ardour for the public good, he was altogether exemplary, and in all his actions he indicated a disinterested and truly independent spirit. See Dr M'Crie's *Life of Andrew Melville, &c.* Edinburgh, 1819.

MEMBER applies to the individuals of some particular order or rank in a state or government, as member of a corporation, member of parliament, &c.

MEMBRANE, MEMBRANA, a thin white expanded skin, consisting of various sorts of fibres interwoven together. See ANATOMY.

MEMEL, or MEMMEL, a town of Eastern Prussia, situated at the northern extremity of the Kurische Haff; has an excellent harbour, and carries on considerable trade. Immense rafts of timber are brought to this place by means of the river Niemen, and various saw mills are erected here. The exports, besides timber, are lintseed, hemp, flax, tallow, and hides. Between 600 and 700 vessels are supposed to trade to Memel, two-thirds of which are British. The population is stated at 6000.

MEMOIRS, a species of history similar to the *Commentarii* of the Romans, and composed by individuals concerned in what is related. The term likewise applies to the journals or transactions of any literary society.

MEMORY is that faculty by which we retain or recal the impression of any thing that is past, from a consciousness that the thing itself was present at a former period. Since the earliest dawnings of philosophy down to our own times, this subject has continued to amuse and interest the speculative, and different philosophers have entertained different ideas regarding it.

The notion of some, that the memory is a mere organ, such as the eye or ear, appears to be altogether incorrect; but this natural faculty of the mind does assuredly depend very much on the state of the nerves and brain. Descartes conceives that the animal spirits exciting a motion in the most delicate fibres of the brain, leave some kind of traces occasioning remembrance. Dr Hartley is likewise of opinion, that memory is a faculty depending entirely or chiefly on the state of the brain, by which traces of sensations and ideas occur or are recalled in the same order or proportion, accurately, or nearly as they were once presented. But, in citing these authorities, it may be remarked with truth, that as we cannot well conceive how the soul and body co-operate, no theory yet advanced does satisfactorily account for the operations of memory, which perhaps must remain the subject of curious enquiry and speculation. Mr Locke's ideas respecting memory are somewhat singular. He considers memory as the store-house of our ideas; and that our ideas, being nothing but actual perceptions in the mind, cease to be when there is no perception of them. This signifies, that the mind has a power to revive perceptions it once had, with this additional perception that it has had them before. He says, "the mind as it were paints them anew upon itself;" but this implies, that the mind must have the memory of what they were, else the copy can never be correct. One of the earliest Greek commentators on Aristotle states the sentiments expressed by the Peripatetics respecting this faculty. They considered it "as a relict which, when the external object is no longer present, remains and is still preserved, being as it were its image, and which, by being thus preserved, becomes the cause of our having memory." The ancient Platonists agreed with the Peripatetics in this theory, and admitted, that "when the former type of things is imprinted on the mind by the organs of the senses, and so imprinted as not be deleted by time, its preservation is called memory. Aristotle on this account imputes the shortness of memory in children to this cause, that their brain is too soft to retain impressions made upon it, and in old people to the hardness of the brain which hinders its receiving any durable impression. These fanciful theories are more amusing than instructive; and, in reasoning on this subject, memory has not unfrequently been confounded with perception and imagination. That eminent philosopher and acute observer Dr Reid, terms memory an original faculty given us by the author of our being, of which we can give no account but that we are so made. I believe most firmly, says he, what I distinctly remember. It is the inspiration of the Almighty that gives me this understanding. The testimony of witnesses depends upon it, and all the knowledge of mankind with regard to past events is built on this foundation."

There is perhaps no faculty of the mind more useful or more important than memory. Without it, indeed, all the other noble powers which man possesses over the inferior animals would be entirely lost, and he would be capable neither of judging nor reasoning, nor of any other intellectual operations. All the knowledge he derives from experience, and even the pleasures of imagination, would be entirely annihilated, and man would sink in the scale of beings far below the rank of the meanest animals. Deprived of this faculty, the present enlightened and happy condition of the human race would be completely changed, and all the most refined pleasures of reflection, imagination, and reasoning would be forever lost. The scale of intelligence in different animals rises or falls chiefly in proportion to the extent and use of this faculty, and its improvement. The training of the elephant, of the dog, of the horse and camel, and of all the other animals whose labours can be converted to the use of man, depend in no small degree upon this primary and fundamental faculty. To man, therefore, how important is its cultivation and improvement.

Memory, according to Dr Beattie, is both active and passive; active when we endeavour to remember what does not immediately, and as it were of itself, occur; and passive when we remember without any particular effort. With regard to susceptibility, this faculty is observed to be most strong in childhood, but retention of mind is enjoyed most perfectly in youth and manhood. It is a fact not a little remarkable, that an extremely retentive memory is but seldom accompanied with acute perception and sound judgment. This faculty, it is evident, is not exclusively confined to our own species, for every day's observation affords indubitable proof that the inferior animals enjoy in no small degree the advantage of this internal sense. After a long absence, the dog happily recognises his master, and a road which a horse has travelled once will be traced back by the animal with remarkable accuracy, a circumstance the more strange, that the appearance and order of the objects he may have passed in going must in his return be reversed. Brutes, however, it is evident, are altogether incapable of measuring time, neither do they possess any knowledge of the interval between things which they remember, or of their distance from the present.

No faculty is of more immediate importance to our race than that of memory. As we appear to deduce our notions of what is possible from our experience of what is past, judgment or reflection consequently implies knowledge already attained. Hence, without the primary advantage of reminiscence, the cultivation of intellect were in a great measure impracticable; and without its efficient aid imagination could not exercise her magical functions, having no fruitful source whence to draw her select ideas, and charm with the attractive air of novelty by agreeable or fanciful association. Horace says finely on this head,

Sounds which address the ear are lost and die
In one short hour; but that which strikes the eye,
Lives long upon the mind; the faithful sight
Engraves the knowledge with a beam of light.

Among the different means suggested for the improvement of this highly pleasurable faculty, nothing should be more urgently inculcated than the propriety of observing strict temperance; for it rarely happens, that an intemperate individual enjoys great retention of mind, and indeed excess of every kind militates against the proper use and exercise of all the faculties of the soul. A habit of strict attention is of essential importance in whatever object of pursuit we may be engaged, as well as a systematic method of procedure in study or business. Here it may not be amiss to notice the advantage which the memory gains by having the several particulars we wish to recollect drawn out into schemes and tables.

A knowledge of mathematical science and natural philosophy, is not only communicated to the understanding, but preserved in the memory, by figures and diagrams. The situation of the several parts of the earth are more readily learned by the transient perusal of a map, than by merely reading the description of them a hundred times over; so likewise may the constellations and their positions be more accurately or more easily remembered by means of correct hemispheres of the stars. By the constant observation of such memorials, no small advantage and improvement may be attained. Moderate and repeated exercise is peculiarly adapted to invigorate and strengthen the memory; and indeed it is almost incredible to what extent daily use will promote this attainment. Some public orators, for example, will distinctly charge the mind with a regular discourse within a very limited time, who at the first experienced the greatest difficulty in attempting to do so. In general, public speakers, especially those at the bar, afford striking instances of the improvement of this noble faculty in recollecting and refuting the arguments of their opponents, and prove to what wonderful perfection the memory may arrive by active and continued practice.

Numerous individuals have been celebrated for their amazing recollective powers of mind; Scaliger, it is said, could repeat a hundred verses or more, after having read them a single time; and Seneca says he could repeat 2000 words on hearing them once, although they had no dependence or connection with each other. Perthicus prepared his Comment upon Claudian without referring to the text; and the learned Florentine Magliabechi is recorded to have possessed such powers of retention as to be capable of recollecting not only the sense of what he read, but likewise at times the very words and the spelling. To prove the power of his prodigious memory, a gentleman lent him a manuscript, and he returned to him some time afterwards, pretending it had been lost, requesting Magliabechi to recollect as much of it as possible, on which, it is said, that he wrote the whole of it without missing a word. Many other examples of a similar nature might be easily quoted, but to enumerate more appears unnecessary; though we must not omit to notice the peculiar powers of calculation witnessed in Jedediah Buxton, a person otherwise illiterate; and a similar phenomenon in the much celebrated American boy Zerah Colburn. The latter, at the early age of eight years, exhibited in London and Edinburgh; and, without any previous knowledge of the ordinary rules of arithmetic, or even of the use and power of the Arabic numerals, and, moreover, without having paid any great attention to the subject, evinced by intuition, as it were, the faculty of solving in his mind, unassisted by any visible symbol or contrivance, a considerable variety of arithmetical questions, which seemingly required difficult and intricate calculations. Another boy, likewise, George Bidder, from Devonshire, has exhibited an astonishing talent for mental calculation, and, under the auspices of Henry Jardine, Esq. is said to have been educated in the city of Edinburgh. See *Edinburgh Philosophical Journal*, Vol. II.

Reminiscence, it is observable, is most efficaciously aided by association or locality, and that system of memory which brings this principle into full operation must certainly be extremely beneficial. Thus the connection of our ideas with places and things properly constitutes the foundation of artificial memory.

MEMORY, ARTIFICIAL, *Memoria Technica*, or the art of assisting the memory, by forming certain words, or transferring a train of ideas to certain objects familiar to the sight; and this artificial method has been termed Mnemonics.

In its more extended sense, it denotes the laws which regulate the exercise of memory; but, in a limited sense, it signifies a system of rules designed to aid that faculty by means of association, and which was called *Memoria Artificialis* by the ancients. Memory, which is no doubt dependant on the state of the body, and especially on that of the nervous system, is, like other faculties, capable of much improvement; and, in assisting it, no means are more beneficial than arrangement and association. Both in ancient and modern times amazing powers of retention have been witnessed; and of instances of the kind an host might be enumerated. No small degree of exaggeration is apparent in many of the accounts of almost miraculous memory on record; and hence it has been matter of doubt whether, in these cases of tenacious memory, any real and practical assistance had been derived from mechanical agents, or if persons gifted by nature with a very good memory had improved it to a great degree by means of unceasing cultivation. Without presuming to decide in this matter, we may venture to affirm, that none of the systems of artificial memory that have yet appeared seem very generally adapted to useful purposes.

Though the natural memory of many individuals is no doubt extremely retentive, all the impressions of the human mind, if they be not occasionally renewed, are inevitably liable to decay. With the view, therefore, of obviating this mental weakness, various means have been devised; and the mnemonic art has been by some cultivated with the greatest ardour. The poet Simonides is famed by the ancients as the inventor of this art, or as having been, without dispute, instrumental in the discovery, as appears from the Parian chronicles, and from the writings of Cicero, Quintilian, and other authors.

It being evident that what we witness with our eyes is not so soon forgotten as what we have merely heard of, the principle of Simonides' scheme consisted in transferring a train of ideas to certain familiar objects of sight. Thus, to imprint a particular discourse on the memory, the plan was to commence at some fixed point of a house well known to the individual, and proceed round it in a circular line to where he set out; then to divide the circumference of the house into the same number of parts that there were separate topics in the discourse, at same time characterizing each paragraph by a mark symbolical of the immediate subject treated of; and so to recal to the mind of the speaker the whole discourse. In this mode of procedure, though apparently tedious and incompatible with many tempers, some degree of utility is perceptible; and somewhat analogous to it is the *local memory* of orators, by means of which they are instantly reminded of what they are to deliver.

Among other methods of aiding the memory which have been suggested, it has been attempted to remember names or sentences by forming a new word of the first letters of the words in the particular name or sentence. In this manner, the appellation Maccabees is formed from the Hebrew sentence *Mi Camoka Bealim Jehovah, i. e.* Who is like thee among the gods? And so likewise the word *Vibgyor* occasions the recollection of the seven primitive colours, violet, indigo, blue, green, yellow, orange, and red, as they are observed by means of a prism, or formed by the sun in a rainbow.

Of the various treatises that have appeared from time to time on the mnemonic art, Dr Grey's *Memoria Technica*, first published in 1730, is perhaps the most valuable and interesting. This performance was favourably thought of by the celebrated Dr Priestley, who remarks, " It is so easily learned, and may be of such use in recollecting dates, when other methods are not at hand, that all persons of liberal education are inexcusable who will not take the small degree of pains that is necessary to make themselves masters of it, or who think any thing mean or unworthy of their notice which is so useful and convenient." In Dr Grey's method the nine digits are exchanged for certain consonants, and for the vowels and some diphthongs, and words are thus formed at pleasure, the letters of which imply some date or aera to be kept in remembrance. The following series, therefore, with their corresponding numbers, are to be thoroughly grounded on the memory.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| a | e | i | o | u | au | oi | ei | ou | y |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 |
| b | d | t | f | l | s | p | k | n | z |

Here the five vowels in order naturally represent 1, 2, 3, 4, 5; the dipthong *au* = 6, as being composed of *a* and *u*, or 1 + 5 = 6; and, for the like reason, *oi* = 7 and *ou* = 9. The diphthong *ei* will easily be remembered for 8, as being the initials of the word. In like manner, where the initial consonants could be conveniently retained, they are made use of to signify the number, as *t* for 3, *f* for 4, *s* for 6, and *n* for 9. The rest were designed without any particular reason, unless that possibly *p* may be more easily remembered for 7, *k* for 8, *d* for 2, *b* for 1, as being the first consonants, and *l* for 5, being the Roman letter for 50, than any others that could have been put in their places. It is further to be observed, that *z* and *y* being employed to represent the cypher, where many cyphers meet together, as 1000, or 1,000,000, instead of a repetition of *a z y*, *z y*, *z y*, &c. let *g* stand for 100, *th* for a thousand, and *m* for a million. Thus *ag* will be 100, *ig* 300, *oug* 900, &c.; *ath* 1000, *am* 1,000,000, *loum* 59,000,000, &c. Fractions may be set down in the following manner: Let *r* signify the line separating the numerator and denominator, the first coming *before*, the other *after* it; as *iro* $\frac{3}{4}$, *urp* $\frac{5}{7}$, *pourag* $\frac{79}{100}$, &c. When the numerator is 1, or unit, it need not be expressed, but begin the fraction with *r*; as *re* $\frac{1}{2}$, *ri* $\frac{1}{3}$, *ro* $\frac{1}{4}$, &c. So in decimals, *rag* $\frac{1}{100}$, *rath* $\frac{1}{1000}$.

Besides this method of expressing numbers by words, much historical, geographical, and other knowledge may be comprised in a set of verses, composed of artificial words, which are to be distinctly impressed on the mind. The art consists in making such a change in the ending of the name of a person, place, or coin, without altering the beginning of it, as shall readily suggest the thing sought; at the same time, that the beginning of the word being preserved, shall be a leading or prompting syllable to the ending of it so changed. Thus, in order to remember the years in which Cyrus, Alexander, and Julius Cæsar founded their respective monarchies, the following words may be formed: for Cyrus Cyr*uts*, for Alexander Alex*ita*, for Julius Cæsar Juli*os*. *Uts* signifies, according to the powers assigned to the letters before mentioned, 536; *ita* is 331, and *os* is 46. Hence it may be easy to remember that the empire of Cyrus was founded 586 years before Christ, that of Alexander 331, and that of Julius Cæsar 46. In the following table, of a few of the kings of England since the Conquest, one thousand being added to the italics in each word denotes the year when the monarchs commenced their reigns.

Will-con*saw*, Ruf*koi*, Hen*rag*.
Steph*bil* and Hensec*buf*.
Jam*syd*, Caroprim*sel*.
Carsec*sok*, Jam*seif*, Wil*seik*, An*pyb*, Geo-*bo*·*doi*-*sy*.

The system of artificial memory thus referred to has been in some degree improved by the author of *Mnemonics Delineated*. In this pamphlet of seven leaves is comprised an amazing variety of information connected with science and ordinary life, which are reduced to a sort of verse, no doubt possessing little harmony, on account of the barbarous combination of vowels and consonants.

Mnemonics has been of late years revived on the Continent by different individuals, but more especially by M. Gregor von Feinagle, who gave, at Paris, London, and Edinburgh, exemplifications of his system, which seems to accord with that of the ancients; and he thereafter published in 1812 his *New Art of Memory*, founded on the principles which he taught. This latter method, though to some perhaps an acquisition, is now in no great repute, from the circumstance that very few have the patience or ability to appropriate it to purposes of utility. But, indeed, after all that has been said on the subject of Mnemonics, it cannot be denied, that, to improve and strengthen the memory, the most effectual method is the moderate and regular exercise of that inestimable faculty; for nothing can be more true than the remark of the celebrated Ruddiman, *Memoria excolendo augetur.*

MEMPHIS, an ancient city, and the residence of the kings in Upper Egypt. See EGYPT.

MENAGE, a collection of animals. It is also termed a Menagery.

MENANDER, an ancient Greek poet, born at Athens in the third year of the 109th Olympiad, and died in the third year of the 122d Olympiad. He obtained great celebrity by his introduction of the new comedy, and is highly spoken of by the ancients, particularly Quintilian, who commends him for copiousness of invention, elegance of expression, and that universal genius which accommodates itself to persons, things, and affections. The works of Menander consisted of 100 comedies; but as only four of his plays remain, it is from Terence chiefly that a judgment is to be formed of him. In the time of Pausanias, his tomb remained close by the honorary monument of Euripides at Athens.

MENDICANTS, or Begging Friars, are several orders of religious in Popish countries, supported solely by charitable donations. They had their origin in the thirteenth century under the auspices of Innocent III.; but their numbers so rapidly increased, that, in a general council held at Lyons in 1272, Pope Gregory X. found it expedient to suppress the extravagant multitude, by confining the mendicants to four orders, namely, the Dominicans, Franciscans, Carmelites, and Augustines. These orders were at full liberty to travel from place to place, and were held in great veneration throughout Europe, on account of their apparent sanctity. Nay, such was the growing enthusiasm of the people towards the mendicants, that cities were expressly allotted to them for their residence; and, in course of time, they were not only entrusted with all spiritual affairs, but likewise with the disposal of the most important political concerns. The Dominicans and Franciscans, in particular, obtained an astonishing ascendency, and became impious in the extreme by their ostentatious presumption. These nefarious beggars exposed themselves to public contempt towards the end of the fourteenth century, but were screened from their adversaries by the agency of the Popes, who found it their interest to assist them. In the fifteenth century they entailed still greater odium upon themselves; and by means of the gradual progress of religious knowledge and civilization in the sixteenth century, their overpowering influence was at length happily annihilated.

MENELAUS, the husband of Helen, brother of Agamemnon, king of Sparta; and his being deprived of his wife by Paris occasioned the famous siege of Troy. See GREECE.

MENGS, ANTHONY RAPHAEL, an eminent painter, born at Ausig in Bohemia in 1728, and died at Rome in 1779. Having been accustomed from infancy to the use of the pencil under the tuition of his father, he had attained such proficiency in his studies as enabled him, at the age of twelve years, to appreciate the sublime works of M. Angelo, Raffaelle, and others, at Rome, whither he had been taken on account of his remarkable talents. After a residence of three years in Italy, he accompanied his father to Dresden, and had the happiness to be appointed cabinet-painter to the king of Poland, when he revisited Rome for the prosecution of his studies, and married with the view of settling in that city. In consequence of a handsome invitation from the king of Spain, Mengs was induced to remove to Madrid in 1761, where he enjoyed the most liberal encouragement. He was, however, soon obliged to return to Rome for the recovery of his health, but was favoured with a pension from his Majesty of 2000 doubloons. Such was the simplicity and extreme generosity of this artist, whose mind indeed was wholly engrossed with enthusiasm for the arts, that though 250,000 livres had been bestowed upon him during the last eighteen years of his life, he hardly left behind him a sufficiency to cover his funeral expenses. His works were published at Parma in 1720, in 2 vols. 4to, with notes and an account of his life. It is said that Mengs wrote all the technical part of Winckelman's *History of the Arts*.

MENISCUS, LUNE, or LUNULA, is a lens, convex on one side and concave on the other. See OPTICS.

MENNONITES, a denomination of Anabaptists, called also Waterlandians from Waterland, a district of North Holland. This sect took its rise in 1536 from Menno Simon, a native of Friesland, who had been previously a Roman Catholic priest, and an unprincipled character. Towards the sixteenth century, they were granted a settlement in the United Provinces by William Prince of Orange, and they were tranquilly established in the following century. The distinguishing principle of the Mennonites, upon which all their opinions are founded, is, that the kingdom of Christ established upon earth is a visible church or community, into which the holy and just alone are to be admitted, and which is consequently exempt from all those institutions and rules of discipline that have been invented by human wisdom for the correction and reformation of the wicked. The Flemingenians, or rigid Mennonites, adhere decidedly to the particular notions of Menno, but have of late relaxed in their remarkably austere habits, and conformed with the Waterlandians. Mosheim's *Ecclesiastical History*.

MENSTRUUM, a term which has been adopted in chemistry to denote any fluid capable of dissolving solid bodies. See CHEMISTRY.

# MENSURATION.

Definition.

Mensuration is the art or method of determining the extension or quantities of figures, by comparing them with some known measures, as a yard, a foot, an inch, &c. This branch of mathematical science is naturally divided into three parts, relating to lines, surfaces, and solids; all of them derived from the same principles, and differing from one another only in the means to be resorted to in ascertaining dimensions in the heavens, on the earth, and on the ocean. This art, besides being of the most extensive use in mathematics, and in every branch of science, is, next to arithmetic, of the greatest importance in the most common affairs of life, since by it commerce is chiefly conducted, and an infinite variety of articles are bought and sold. It supplies the means of making those calculations that are requisite for the construction of all machines; it ascertains the extent of lands and of buildings, the bulk of all bodies, and the capacities of all vessels, as well as the fluids they contain. The properties of figure having already been sufficiently discussed under Mathematics, we shall now proceed to treat, 1st, Of the mensuration of surfaces; 2d, Of solids; and, 3d, Of heights and distances.

## Part I. Mensuration of Surfaces.

### Sect. I. *Of the Areas of Right-lined Figures.*

*Problem* 1.—To find the area of any right-angled quadrilateral figure. Fig. 1. Plate 125.

*Rule.*—Multiply together any two of the sides adjacent to the same angle, for the area.

*Problem* 2.—To find the area of any quadrilateral, where the angles are oblique, and the opposite sides equal to one another. Fig. 2.

*Rule* 1.—Multiply two adjacent sides together, and the product by the natural sine of the included angle, which last product will be the area.

*Rule* 2.—Multiply the length by the perpendicular breadth.

*Problem* 3.—To find the area of a triangle. Fig. 3.

*Rule* 1.—Multiply the base by half the perpendicular drawn to it from the opposite angle.

*Rule* 2.—Multiply two adjacent sides together, and the product by the natural sine of the included angle, then take half the last product for the area.

*Rule* 3.—From half the sum of the three sides, substract each side severally: multiply the half sum and the three remainders continually together, and extract the square root of the last product for the area.

*Algebraically.*—If $x$ be the area, $a$, $b$, and $c$ the three sides respectively, and $s$ half the sum of the three sides.

Then $x = \surd\,[s \times (s-a) \times (s-b) \times (s-c)]$

*Problem* 4.—To find the area of a trapezium. Fig. 4.

*Rule.*—Divide the figure into any number of triangles that may be convenient; then compute their several areas according to the foregoing rules, which areas, collected into one sum, will be the area of the trapezium.

Surfaces.

When the trapezium has only four sides, draw two diagonals joining the opposite angles;—multiply these diagonals together, and their product by the natural sine of the angle at the intersection for the area.

*Problem* 5.—To find the areas of regular figures, or polygons. Fig. 6.

*Rule* 1.—Multiply the sum of the sides of the figure by the perpendicular drawn from the centre to one of the sides, and half the product will be the area.

*Rule* 2.—Multiply the square of the side by the corresponding tabular area, or multiplier, standing opposite its name in the following table, and the product will be the area:—

| No. of Sides. | Names. | Multipliers or Area, when the side is 1. |
|---|---|---|
| 3 | Trigon or equi △ | 0·4330127 |
| 4 | Tetragon or □ | 1·0000000 |
| 5 | Pentagon, | 1·7204774 |
| 6 | Hexagon, | 2·5980762 |
| 7 | Heptagon, | 3·6339124 |
| 8 | Octagon, | 4·8284271 |
| 9 | Nonagon, | 6·1818242 |
| 10 | Decagon, | 7·6942088 |
| 11 | Undecagon, | 9·3656399 |
| 12 | Dodecagon, | 11·1961524 |

### Sect. II. *Of the Circle.*

*Problem* 1.—To find the diameter and circumference of a circle, the one from the other. Fig. 7.

The ratio generally used in practice is that of the great Archimedes, as under:—

*Rule.*—As 1 is to 3·1416, so is the diameter to the circumference.

As 3·1416 to 1, so is the circumference to the diameter; or, as 355 to 113 nearly.

Mr Abraham Sharp found the ratio of the diameter of the circumference to be as 1 to only the ten hundred thousand billionth part of a very minute fraction, being a degree of exactness millions of times more than sufficient for any question in mathematical science.

*Problem* 2.—To find the length of any arc of a circle. Fig. 8.

*Rule.*—As 180 is to the number of degrees in the arc, so is 3 1416 times the radius to its length; or, as 1 is to the number of degrees in the arc, so is .0174533 times the radius to its length.

*Problem* 3.—To find the area of a circle. Fig. 9.

*Rule* 1.—Multiply half the circumference by half the diameter, and the product will be the area.

*Note.*—This rule will also serve for any sector of a circle.

*Rule* 2.—Multiply the square of the diameter by ·7854, and the product will be the area.

*Problem* 4.—To find the area of any sector of a circle. Fig. 8.

*Rule* 1.—Multiply the radius, or half the diameter, by half the arc of the sector, for the area.

*Rule* 2.—As 360 is to the degrees in the arc, so is the whole area of the circle to the area of the sector.

*Problem* 5.—To find the area of the segment of a circle. Figs. 8. and 9.

*Rule.*—By the last problem find the area of a sector, having the same arc with the given segment.

Find the area of the triangle bounded by the chord and the two radii of the sector.

Then the sum or difference of these areas will be that of the segment, according as it is greater or less than a semicircle.

*Problem* 6.—To find the area of a zone, or the space lying between two parallel chords of a circle. Fig. 9.

*Rule.*—Find the area of each segment, (one on each side of the zone,) substract their sum from the area of the whole circle, and the remainder will be the area of the zone.

*Problem* 7.—To find the area of the ring included between the circumferences of two concentric circles. Fig. 10.

*Rule* 1.—Multiply the sum of the diameters by the difference of the diameters, and the product again by ·7854, for the area of the ring.

*Rule* 2.—Multiply the sum of the circumferences by half the difference of the diameters, and the product will be the area.

*Problem* 8.—To find the areas of lunes, or the spaces included between the intersecting arcs of two excentric circles. Fig. 11.

*Rule.*—From the area of the larger segment, subtract the area of the lesser, and the remainder will be the area.

### *Of Land-Surveying.*

The instruments most useful for this purpose, are the chain, the theodolite, and plane-table. There being 160 square poles in a statute acre of land, the chain, commonly called Gunter's chain, is made to consist of 4 poles, or 66 feet; so that 10 square chains, or 100,000 square links, make one square acre. The plane-table being of a rectangular form, with a movable frame adapted for fixing a sheet of paper, is for drawing the plan of the field, and such angles as may be required for calculating its contents. This table being furnished with an index, and with scales of equal parts, lines may be drawn upon the paper in the direction of any object in the field, and proportioned to the distances of the objects from the table when measured by the chain. In taking angles, however, no instrument is equal for accuracy to the theodolite.

Problem 1.—*Measurement of a field with the chain.*—Let A *a* B C D *b*, (Fig. 12. Plate 125.) be the field required to be measured. Let it be divided into the triangles A *a* B, A B C, A C D, A *b* D, &c. Let the sides of the larger triangles, A B C, A C D, and the perpendiculars of the smaller ones, A *a* B, A *b* D, be measured by the chain, from the vertices *a*, *b*, and their contents ascertained, their sum will be the amount of the whole. Should the sides of the field be so irregular that it cannot be wholly divided into triangles, in this case such a straight line may be drawn, that the parts cut off, and those added, may be nearly equal. The magnitude of the curved spaces may be taken so small, that without any perceptible error they may be measured as a number of trapezoids.

Problem 2.—*Measurement of a field with the plane-table.*—Let A B C D E (Fig. 13.) be the field, and the plane-table fixed at F; and let the distances F A, F B, F C, &c. be measured with the chain from the corners of the field. Direct the index from any assumed point successively to the points A, B, C, &c. and let the lines F *a*, F *b*, F *c*, &c. be drawn in the direction of these points. Let the angles contained by these lines be marked, and let the lines themselves be proportioned to the distances, measured by the scale of equal parts. Let the extremities be joined; then the figure of the field will be formed, *a b c d e*; and by calculating the areas of the triangles of which it is composed, the area of the field will thus be ascertained.

Problem 3.—*Method of drawing the plan of a field from a given base line.* (Fig. 14.)—Let there be taken two stations, A, B, within the field, and the distance measured. Let the plane-table be fixed at A, and the point *a* be placed directly over A; and the index being directed to B, let the straight line, *a b*, be drawn in that direction, to represent A B. Let the index from *a* be pointed to an object at C, and a line drawn in the same direction along the side of it, and so successively of every corner; then let the table be placed at B, having *b* directly above it, and *b a* directly above B A, and in the direction of B C; let a straight line be drawn from *b*, then the intersection of that line with the former must determine the position of the point *c*, so that the triangle *a b c* in the plan will be exactly similar to the triangle of A B C in the field, and all the other angular points may be determined in the same manner; so that, when joined, the figure of the field will be thus accurately represented. The rules given above are applicable to the work of carpenters, glaziers, and other artificers, as far as surfaces are concerned. But the reader, who may be desirous of investigating the subject more particularly, is referred to Crocker's *Treatise on Surveying*, in which he will find the most ample information.

## PART II. MENSURATION OF SOLIDS.

The measure of any solid is termed its capacity, solidity, or contents; and being measured by cubes, the sides of which are inches, feet, or yards, the solidity of any body is therefore said to be so many inches, feet, or yards as may be sufficient to fill its capacity, or any other space of equal magnitude.

### SECT. I. *Of Prisms, Pyramids, the Sphere, and the Circular-Spindle.*

*Problem* 1.—To find the solidity of a prism. Figs. 15. and 16.

*Rule.*—Multiply the area of the base by the height, and the product will be the solidity.

*Note.*—This rule applies also to the cylinder.

# MENSURATION.

PLATE 125

Fig. 1.

Fig. 2.

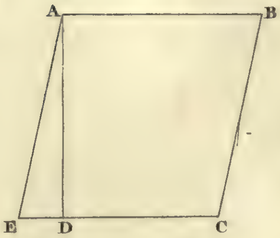


Fig. 3.

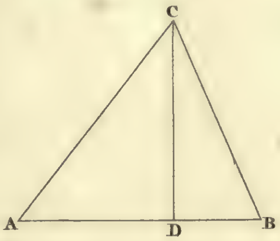


Fig. 4.

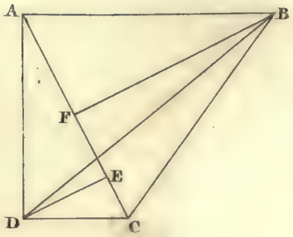


Fig. 5.

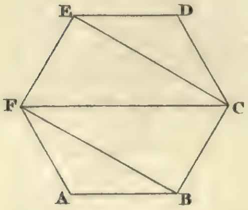


Fig. 6.

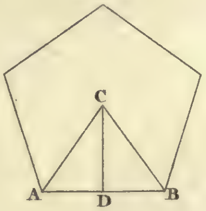


Fig. 7.

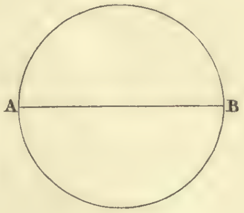


Fig. 8.

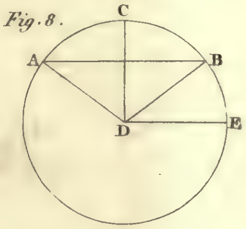


Fig. 9.

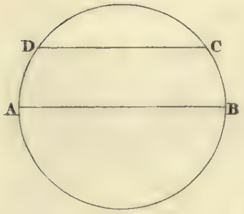


Fig. 10.

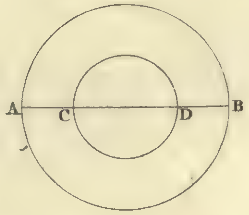


Fig. 11.

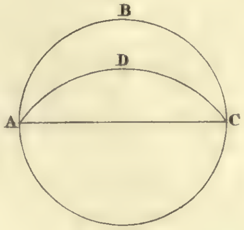


Fig. 12.

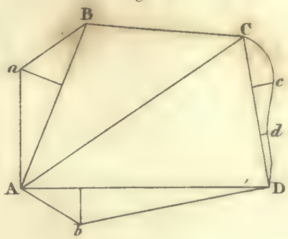


Fig. 13.

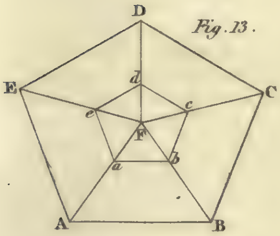


Fig. 14.

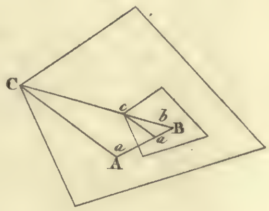


Fig. 15.

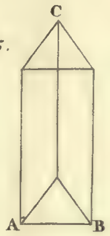


Fig. 16.

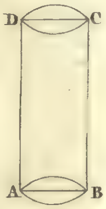


Fig. 17.

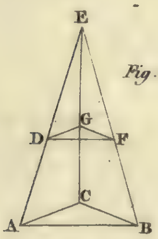


Fig. 18.

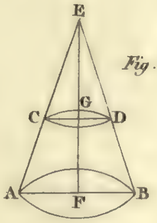


Fig. 19.

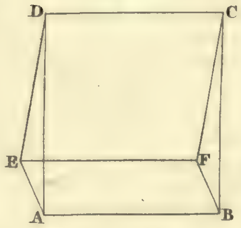


Fig. 20.

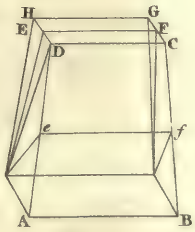


Fig. 21.

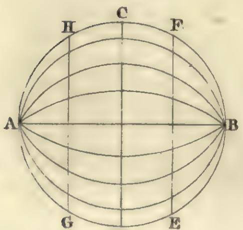


Fig. 22.

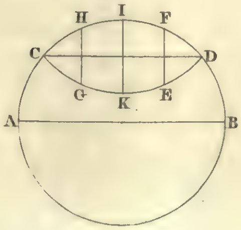


Fig. 23.

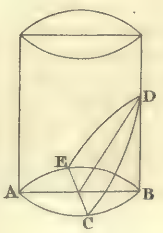
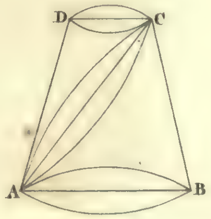


Fig. 24.



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*Problem* 2.—To find the surface of a right pyramid. Figs. 17. and 18.

*Rule.*—Multiply the perimeter of the base by the slant height or length of the side, and half the product will be the sum of all the areas which form it.

*Problem* 3.—To find the surface of the frustum of a right pyramid. Figs. 17. and 18.

*Rule.*—Multiply the sum of the perimeters of the ends by the slant height, and half the product will be the surface.

*Problem* 4.—To find the solidity of a pyramid. Figs. 17. and 18.

*Rule.*—Multiply the base by $\frac{1}{3}$ of the perpendicular height for the solidity.

*Note.*—This rule also embraces the cone.

*Problem* 5.—To find the solidity of the frustum of a pyramid. Figs. 17. and 18.

*Rule.*—Add into one sum the areas of the two ends, and the mean proportional between them; multiply that sum by the perpendicular height, and $\frac{1}{3}$ of the product will be the solidity:—That is, if A be the area of the greater end, $a$ that of the lesser, and $h$ the height, then $(A + a + \sqrt{A\,a}) \times \frac{1}{3}, h$ is the solidity.

*Problem* 6.—To find the solidity of a wedge. Fig. 19.

*Rule.*—To twice the length of the base add the length of the edge; multiply the sum by the breadth of the base, and the product by the height of the wedge, and $\frac{1}{6}$ of the last product will be the solidity.

*Note.*—If the length of the edge be equal to the length of the base, the wedge will be equal to half a prism of the same base and height, or equal to half the product of the base and height.

*Problem* 7.—To find the solidity of a prismoid. Fig. 20.

*General Rule.*—To the sum of the areas of the two ends add four times the area of a section parallel to and equally distant from both ends; multiply the last sum by the height, and $\frac{1}{6}$ of the product will be the solidity.

*Particular Rule.*—Or, if the bases be dissimilar rectangles, take two corresponding dimensions, and multiply each by the sum of double the other dimension of the same end and the dimension of the other end corresponding to this last dimension; then multiply the sum of the products by the height, and $\frac{1}{6}$ of the last product will be the solidity.

*Problem* 8.—To find the solidity of the two parts called ungulas or hoofs, into which the frustum of a rectangular or a square pyramid, or a rectangular prismoid, is cut by a plane inclined to its base. Fig. 20.

*Case* 1.—If the dividing plane coincides with one of the sides of the base, and cuts the upper surface into two parts, it will divide the figure into a wedge and a prismoid, whose solidities may be found by the rules of Problems 6 and 7.

*Case* 2.—If the dividing plane passes through the diagonal of two opposite sides, the solid is thereby divided into two wedges or hoofs, whose bases are the ends or bases of the solid, and then the contents of the two parts will be found by Problem 6.

*Case* 3.—If the dividing plane coincides with one of the boundaries of the base, and falls on the opposite side, the part cut off will be a wedge, which being taken from the whole figure will leave the content of the remaining part.

*Problem* 9.—To find the curve surface of a sphere, or of any segment or zone of it. Fig. 21.

Multiply the circumference of the sphere by the height of the part required, and the product will be the curve surface, whether it be segment, zone, hemisphere, or the whole sphere.

*Note.*—The height of the whole sphere is its diameter.

*Problem* 10.—To find the lunar surface included between two great circles of a sphere. Fig. 21.

*Rule* 1.—Multiply the diameter of the sphere by the breadth of the surface in the middle, that is, by the arc which measures the angle of inclination of the two circles, and the product will be the surface.

*Rule* 2.—As four right angles to the surface of the sphere; or, as one right angle to a great circle of the sphere, so is the angle made by the two great circles to the surface included by them.

*Problem* 11.—To find the area of a spherical triangle, that is, the spherical surface included by the arcs of three great circles of the sphere intersecting one another. Fig. 21.

*Rule.*—As 8 right angles or 720° to the surface of the sphere; or, as 2 right angles or 180° to a great circle of the sphere, so is the excess of the three angles above two right angles to the area of the triangle.

*Problem* 12.—To find the area of a spherical polygon, or the spherical surface included by any number of intersecting great circles. Fig. 21.

*Rule.*—As 8 right angles or 720° to the surface of the sphere; or, as 2 right angles or 180° to a great circle of the sphere, so is the excess of all the angles above the product of 180, and two less than the number of angles to the area of the spherical polygon.

*Problem* 13.—To find the surface included between two intersecting little circles of a sphere. Fig. 21.

*Rule.*—Through the intersections and poles of the two little circles, draw great circles.

By Problem 11. find the area of one of the great triangles, having first found the angles of the same by the principles of spherical trigonometry.

By Problem 9. find the surface of the segment cut off by one of the little circles, thus, viz. as the diameter is to the versed sine of the arc, so is the surface of the sphere to that of the segment.

Then, as 4 right angles to the great spherical angle at the pole of one of the lesser circles, so is that surface to the part of it contained between the pole and the lesser circle.

In the same manner find the surface of the other triangle contained between the other pole and its lesser circle.

Then, from the sum of the two triangles last found, subtract the whole space included by the four great circles, and the remainder will be the surface included between the two little circles.

*Problem* 14.—To find the solidity of a sphere or globe. Fig. 21.

*Rule* 1.—Multiply the surface by $\frac{1}{3}$ of the radius for the solidity.

*Rule* 2.—Multiply the cube of the diameter by ·5236, and the product will be the solidity.

*Problem* 15.—To find the solidity of the segment of a sphere. Fig. 21.

*Rule* 1.—To three times the square of the radius of its base add the square of its height; multiply the sum by the height, and the product by ·5236 for the solidity.

*Rule* 2.—From three times the diameter of the sphere subtract twice the height of the segment; multiply the difference by the square of the height, and the product by ·5236 for the solidity.

*Problem* 16.—To find the solidity of a frustum or zone of a sphere. Fig. 21.

*Rule.*—Add together the squares of the radii of the ends, and $\frac{1}{3}$ of the square of their distance, or of the height; multiply the sum by the said height, and the product again by 1.5708 for the content.

*Problem* 17.—To find the solidity of the middle zone of a sphere. Fig. 21.

*Rule.*—Multiply either the sum of the square of the diameter of the end and $\frac{2}{3}$ of the square of the height, or the difference between the square of the diameter of the sphere and $\frac{1}{3}$ of the square of the height, by the height, and the product by ·7854 for the content.

*Problem* 18.—To find the surface of a circular spindle, or of any segment or frustum of it. Fig. 22.

*Rule.*—From the product of the height of the solid and radius of the resolving arc, subtract the product of the said arc and central distance; multiply the remainder by 3·1416, and double the product will be the surface described by that arc, whether it be the whole or any part of the spindle.

*Problem* 19.—To find the solidity of a circular spindle. Fig. 22.

*Rule.*—From $\frac{1}{3}$ of the cube of half the length of the spindle, subtract the product of the central distance and half the generating circular segment; multiply the remainder by 4 times 3.14159, and the product will be the content of the spindle.

*Problem* 20.—To find the contents of the segment of a circular spindle. Fig. 22.

*Rule.*—From three times half the length of the spindle, subtract the height of the segment, and multiply the remainder by the square of the said height; from $\frac{1}{3}$ of the product subtract double the product of the generating area and central distance, then the remainder drawn into 3·14159 will produce the content.

### Sect. II. *Of Cylindric and Conic Ungulas.*

*Definition.*—An ungula, or hoof, is a part cut off a solid by a plane oblique to the base.

*Problem* 1.—To find the curve surface of the ungula of a cylinder. Fig. 23.

*Rule.*—From the product of the diameter and sine of the base, subtract the product of the arc and cosine; then multiply the difference by the height, and divide by the versed sine.

*Problem* 2.—To find the solidity of the ungula of a cylinder. Fig. 23.

*Rule.*—From $\frac{2}{3}$ of the cube of the right sine, subtract the product of the base and cosine of half the arc of the base; then multiply the difference by the height, and divide by the versed sine, the quotient will be the solidity required.

*Problem* 3.—To find the solidity of the elliptic hoofs of the frustum of a cone made by a plane cutting diagonally the opposite extremities of the ends. Fig. 24.

*Rule.*—Take the difference between the square of the diameter of the base of the hoof, and the product of the diameter of the other end of the frustum, and a mean proportional between the diameters; divide that difference by the difference of the diameters; multiply the quotient by the height of the hoof, and the product by the diameter of its base; so shall the last product, multiplied by ·2618, give the content of the hoof.

### Sect. III. *Of the Regular Bodies.*

*Definitions.*—1. A regular solid or body is a solid contained under some number of like, equal, and regular plane figures or faces.

2. There are five sorts of regular solids, viz. The tetraedron, or regular triangular pyramid, having four triangular faces, Fig. 1.; the hexaedron, or cube, having six square faces, Fig. 2.; the octaedron, having eight triangular faces, Fig. 3.; The dodecaedron, having twelve pentagonal faces, Fig. 4.; and the icosaedron, having twenty triangular faces, Fig. 5.

*Problem* 1.—To find the surface of a tetraedron. Fig. 1.

Multiply the square of the linear edge by the square root of 3, and the product will be the whole surface.

*Problem* 2.—To find the solidity of a tetraedron. Fig. 1.

Multiply $\frac{1}{12}$ of the cube of the linear side by the root of 2, and the product will be the solidity.

*Problem* 3.—To find the surface or solidity of a hexaedron or cube. Fig. 2.

It is evident that six times the square of the linear side will be equal to the whole surface, and the cube of the linear side equal to the solidity of the hexaedron or cube.

*Problem* 4.—To find the surface of an octaedron. Fig. 3.

Multiply the square of the linear side by the root of 3, and double the product will be the surface.

*Problem* 5.—To find the solidity of an octaedron. Fig. 3.

Multiply the cube of the linear side by the root of 2, and $\frac{1}{3}$ of the product will be the content.

*Problem* 6.—To find the surface of a dodecaedron. Fig. 4.

To 1 add $\frac{2}{5}$, or $\frac{4}{10}$ of the root of 5, multiply the root of the sum by 15 times the square of the linear side, and the product will be the surface.

*Problem* 7.—To find the solidity of a dodecaedron. Fig. 4.

To 21 times the root of 5 add 47, and divide the sum by 40; multiply the root of the quotient by 5 times the cube of the linear side, and the product will be the solidity.

*Problem* 8.—To find the surface of an icosaedron. Fig. 4.

Multiply 5 times the square of the linear side by the root of 3 for the surface.

*Problem* 9.—To find the solidity of an icosaedron. Fig. 5.

To 7 add three times the root of 5, divide the sum by 2, multiply the root of the quotient by $\frac{5}{6}$ of the cube of the linear side for the solidity.

*Problem* 10.—To find the superficies or solidity of any regular body.

1. Multiply the proper tabular area (taken from the following table) by the square of the linear edge of the solid for the superficies.

2. Multiply the tabular solidity by the cube of the linear edge for the solid content.

*Surfaces and Solidities of Regular Bodies.*

| No. of Sides. | | Surface. | Solidity. |
|---|---|---|---|
| 4 | Tetraedron | 1·7320508 | 0·1178513 |
| 6 | Hexaedron | 6·0000000 | 1·0000000 |
| 8 | Octaedron | 3·4641016 | 0·4714045 |
| 12 | Dodecaedron | 20·6457788 | 7·6631189 |
| 20 | Icosaedron | 8·6602540 | 2·1816950 |

### SECT. IV. *Of Solid Rings.*

*Definition.*—A ring is a solid returning into itself, of which every section perpendicular to the arc, or line passing through the middle of the solid, is every where the same figure and of the same magnitude.

*Problem.*—To find the surface and solidity of a ring. Fig. 10, Plate 125.

1. Multiply the arc by the perimeter of a section perpendicular to it, for the surface.

2. Multiply the arc by the area of a section perpendicular to it, for the solidity.

*Scholium.*—It being evident, that the above methods apply to every variety of solid rings, to enter on any particular cases would be unnecessary.

### *Of Gauging.*

Gauging is the art of measuring the capacities of all kinds of vessels, and the quantities of fluids or other matters which they contain. These may be of various kinds and dimensions, but those of most common use are coolers, backs, vats, pipes, tuns, barrels, &c. By the preceding rules may easily be found the solid contents of vessels of these kind of figures in feet or inches, which may be converted into liquid measure by considering that a wine gallon consists of 231 cubic inches, and an ale gallon of 282. *See Measure.* Casks are usually divided into four varieties of forms, deriving their names from the supposed resemblance they bear to the frustums of solids of the same denomination.

1. The middle frustum of a spheroid.
2. The middle frustum of a parabolic spindle.
3. The two equal frustums of a paraboloid.
4. The two equal frustums of a cone.

Casks of these various forms and their contents may easily be measured by the preceding rules; but the figures these casks or barrels may be supposed to resemble must be entirely hypothetical, and for this reason the contents, as found by experiment, very rarely agree with those found by calculation. Excise-officers, therefore, to save themselves the trouble of these calculations, usually ascertain the contents of vessels by scales constructed for this purpose, or by a gauging-rod. This instrument consists of four pieces, each a foot long and about three eighths of an inch square, with three brass joints for the purpose of folding. On one face of this rod or instrument is a double line of diagonals, one appropriated for wine, the other for beer measure. The measurement is taken by inserting the lower end of the rod at the bung of a cask, and directing it obliquely till it touch the junction of the head and stave, and noting the figures opposite the centre of the interior of the bung-hole. As every cask has not the bung truly centrical, care must be taken to measure towards both chines, and if any difference shall appear the medium of the two measurements serves as a standard. In open vessels the oblique line from the surface is measured, or from one side to the bottom of the other side, and half the quantity exhibited on the scale is taken for the contents. On the same instrument is a scale for cylindrical vessels, determining the contents of one inch deep in any given area or diameter. As the curves of staves vary much, complete accuracy is not to be expected from this rod, however justly it may have been graduated; and therefore gaugers in excise-offices generally understand at sight if any unusual curve exists, for which they readily make allowance.

The scale for the London casks is generally graduated by placing the vessel level, and pouring in one gallon of water at the bung-hole if it be a lying cask, or at the head, if a standing cask; and where the surface cuts the rod marking the division for one gallon, then by pouring in another gallon, and likewise marking the division, and thus successively till the cask be full. The division for quarts, marked by dots on the rod, are likewise made by pouring in a quart of water successively, and marking as above. This rod likewise shews what cask is in hand; for by measuring the depth of the bung, if it cut 36, it is a barrel; if 18, it is a kilderkin, &c.; and by the line for that cask its ullage may also be taken, that is, the quantity either drawn out or remaining in the cask.

In measuring the contents of vessels, the following general rule is given by Dr Hutton, by which the content of any cask may be nearly found in wine or ale gallons.

*Rule.*—Add into one sum 39 times the square of the bung diameter, 25 times the square of the head diameter, and 26 times the product of the diameters. Multiply the sum by the length, and the product by ·00034; this last product divided by 9 will give the wine gallons, and by 11 will give the content in ale gallons. By a proper application of the rules already given, the contents of great coppers, mashing tubs, corn binns, and a great variety of similar vessels, may be obtained, as well as the contents of stone, timber, and other bodies.

Sealed casks are likewise measured by the calibre compasses, which are adapted for the outside measure; and, in this case, an allowance is usually made of an inch and a half in the whole length, and the same in the whole diameter at the bung and chine, for the thickness of the cask, and making an allowance according to the apparent swell or budge be-

Heights and Distances.

tween the bung and the chine, and according to wine or ale measure.

The reader will find every information he can desire on this useful branch of science in Dr Hutton's admirable treatise on this subject, to which he is therefore referred, should he be inclined to prosecute this study.

### Part III. Of Heights and Distances.

Heights and distances may be ascertained, if accessible, by applying to them some certain measure a number of times, as an inch, foot, yard, or chain; but if inaccessible, must be determined by measurement of angles and accessible lines, by means of suitable instruments and the principles of geometry. The height of any object above the horizon may be found several ways,—by the quadrant, the square, the theodolite, by two staffs, a plain mirror, the surface of water, or by some graduated instrument. Heights may be measured, 1st, by the chain already described; 2d, by the quadrant. This instrument is made of brass or wood, and is the fourth part of a circle, whose radius may be of any convenient length, and whose circumference is divided into 90 equal parts, and these parts again subdivided as far as they may be required or will admit. From the centre is suspended a plummet by a cord or thread, and on one of the radii two sights are fixed. See Fig. 34. Plate 126.

1. By the Square or Quadrant.—This instrument is likewise formed of the same materials, and has two of its sides divided into 100 equal parts. It is likewise furnished with a plummet and an index, is generally distinguished by the name of the geometrical square, and is commonly used for finding the proportion of the sides of a right-angled triangle. See Figs. 7. and 8.

2. The Theodolite, so useful in the measurement of horizontal and vertical angles, consists of a circle of brass, of about a foot diameter, having its limb divided into 360 degrees, and each degree subdivided either diagonally or otherwise into minutes. It is furnished with four plain sights, two of them fastened on the limb, and two on the ends of the index; and some of them have telescopes likewise, together with a compass-box and spirit-level. See *Level*, Plate 110.

*Problem* 1.—To measure the heights of an accessible object.

1. Measure a base line terminating at the bottom of the object, and, at the farther extremity of the said base line take an angle of altitude. Then, as radius 90° to logarithm of the base, so is tangent angle of elevation to logarithm of the required height.

*Example.*—Suppose a base line measured horizontally from the bottom of a tower, and the angle of elevation, at the distance of 400 feet, found to be 29° 30′. Required the height. See Plate 126, Fig. 9.

| | |
|---|---|
| As radius 90° - - - | 10·000000 |
| Is to log. A B 400 - - | 2·602060 |
| So is to log. tangent ∠ B A C 29° 30′ | 9·752642 |
| To log. of height B C = 226·3 | 2·354702 |

Heights and Distances.

3. By the Quadrant, Fig. 10.—Let any distance, B A, be measured by a chain in a direct line from B C, which falls from the top of the tower. Standing at the point A, let the quadrant be held so that the eye at D may have a view of the object C along the side of the quadrant D F. Then the line of the plummet F P will be perpendicular to the horizon, and parallel, therefore, to B C. The angles D F P, D C E, are consequently equal, and their compliments, G F P, C D E, also equal. Hence, G N, the arch of the quadrant, will shew the number of degrees in the angle of elevation C D E. Hence, in the right-angled triangle C E D, the side D E = A B, and the angle C D E being given, C E may also be found by this proportion: As radius to tangent of C D E, so is D E to E C, to which D A, the height of the eye being added, the whole height of the object is obtained. If the angle of elevation be 45°, then D E = E C; that is, the distance measured is equal to the height of the object above the eye.

4. By the Square, Fig. 11.—Measure A B, as above, and hold the square to the eye, D, as in the former. Then the plummet line F P cuts off from the square a small triangle similar to C D E. Hence we shall find the proportion of D E to E C; and the former being given, the latter may also be found by the same proportion.

5. By two Staffs, Fig. 12.—Let a longer staff, D E, and a shorter one, F G, be placed perpendicularly in the ground, so that A, the top of the height to be measured, may be seen over the ends D, F, of the staffs; let F H and F C, parallel to the horizon, meet D E and A B in H and C; then the triangles F H D, F C A, shall be equiangular, because the angles at C and H are right ones; likewise the angle A is equal to F D H, and consequently the remaining angles are also equal. Therefore, as F H, the distance between the two staffs, is to H D, the excess of the longer above the shorter, so is F C, the distance of the shorter staff, from the tower, to C A, the excess of the tower above the shorter staff; and, therefore, C A will be found by the rule of proportion. To this, if the length F G be added, the whole height of the tower, B A, will thus be found. The same height may also be measured by the length of the shadow; for though the plane on which the shadow falls may not be parallel to the horizon, yet, if the staff be erected on the same plane, the rule will be the same.

6. By means of a Plane Mirror, Fig. 13.—Let the height to be measured be A B; let the mirror be placed at C, at a specified distance, B C, in the horizontal plane B D, and let the observer move back to D, till, in the mirror, he observe the top of the summit at a certain point, which must be accurately marked, and let D E be the height of the observer's eye. The triangles A B C and E D C are equiangular, since the angles D and B are right angles, and A C B, E C D are equal, being the angles of incidence and reflection of the ray A C; consequently the remaining angles at A and E are likewise equal. Hence, as C D is to D E, so is C B to B A.

The surface of clear stagnant water being parallel to the horizon, may be used in place of a mirror.

# MENSURATION

PLATE 126

Fig. 1.

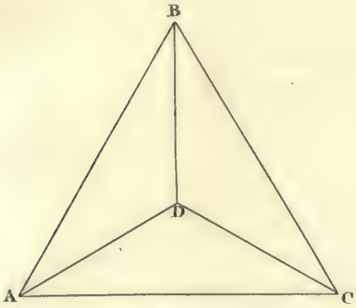


Fig. 2.

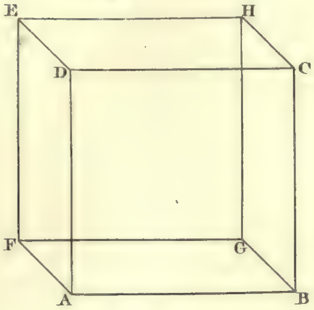


Fig. 3.

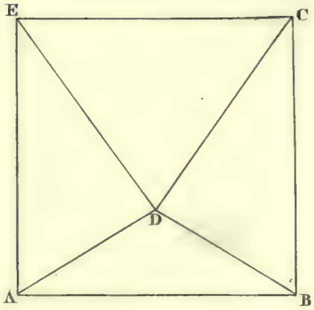


Fig. 4.

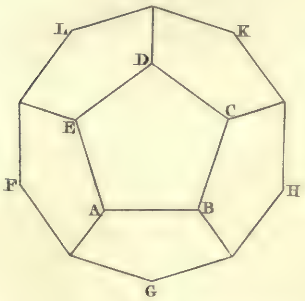


Fig. 5.

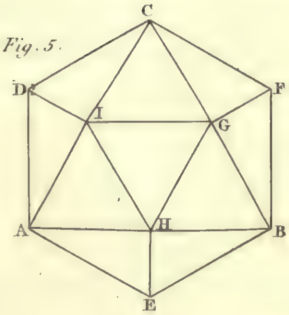


Fig. 6.

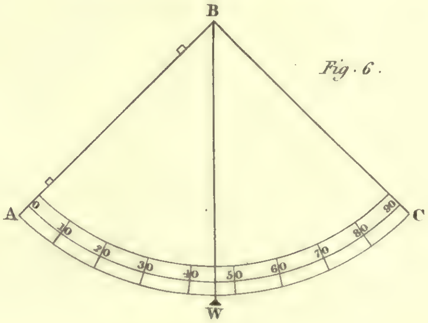


Fig. 7.

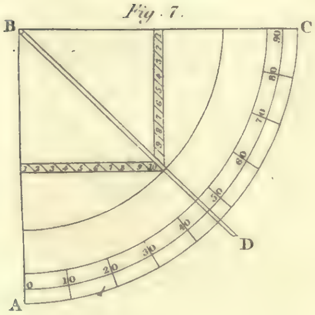


Fig. 8.

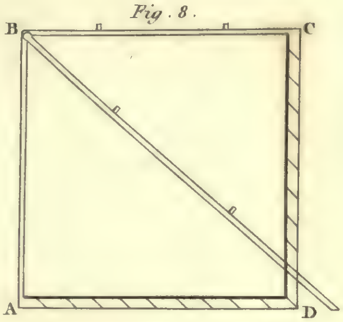


Fig. 9.

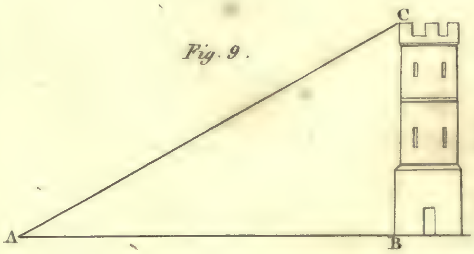


Fig. 10.

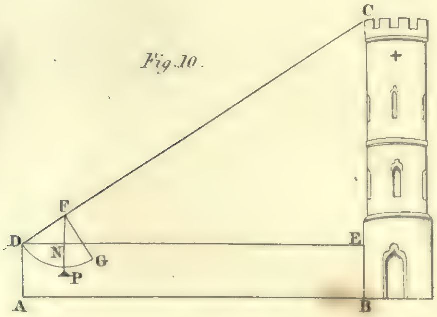


Fig. 11.

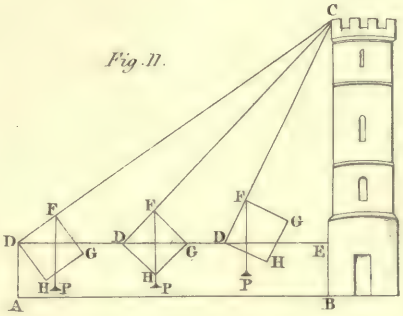


Fig. 12.

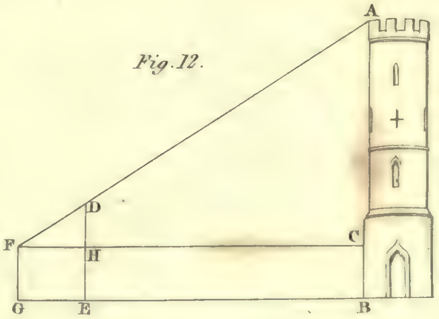


Fig. 13.

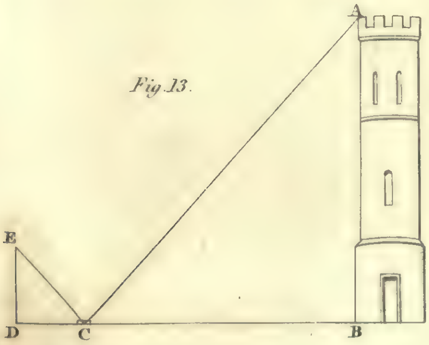


Fig. 14.

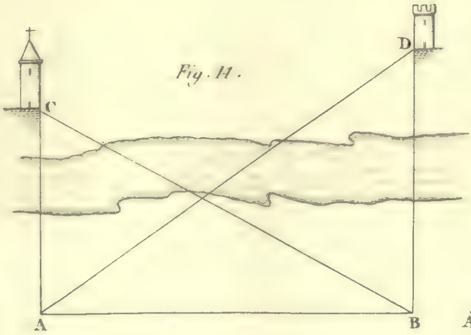
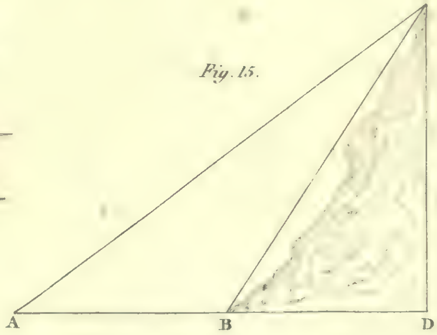


Fig. 15.



Engraved for the Encyclopaedia Edinensis by W. Miller

Heights and Distances.

*Problem* 2.—To measure the height of an inaccessible object.

After measuring a base line at any convenient distance, and measuring an angle of elevation at each extremity of said line,—then make the following analogy: As the logarithmic sine of the difference of the two angles of elevation is to the logarithm of the base, so is the log. sine of the lesser angle to the logarithm of the opposite side: Then, as radius is to the log. of side last found, so is the sine of the larger angle at the base to the log. of the height.

*Example.*—Near the base of a mountain, I took the angle of elevation of its summit, 23° 5′, and walked backward, in a straight line, to the distance of 1830 feet, and there found the angle of elevation to be 13° 45′: Required the height of the mountain, and the horizontal distance of its summit from the nearest station. Fig. 15.

To find the height.

| | |
|---|---|
| As log. sine ∠ C, 9° 20′, - | 9·209992 |
| To log. A B, 1830, - - - | 3·262451 |
| So log. sine ∠ A, 13° 45′, - | 9·376003 |
| To log. of B C, 2682, - - | 3·428462 |

*Note.*—In every similar case, the angle A C B is equal to the difference between the angles C A D and C B D. Then,

| | |
|---|---|
| As radius 90°, - - - | 10·000000 |
| To log. of 2682, - - - | 3·428462 |
| So log. sine ∠ B, 23° 5′, - | 9·593363 |
| To height C D, 1052 feet, - | 3·021825 |

To find the horizontal distance, B D.

| | |
|---|---|
| As radius 90°, - - - | 10·000000 |
| To log. of 2682, - - - | 3·428462 |
| So log. sine ∠ B C D, 66° 55′, | 9·963757 |
| To log. of distance, 2467 feet, | 3·392219 |

*Problem* 3.—To find the distance of inaccessible objects, by measuring a base line and horizontal angles.

*Example.*—Suppose that two objects, C D, (Fig. 14.) on the other side of a river, have the following relations to the base line A B, (360 yards long): The angle C A B, 90° 20′. ∠ C B A, 43° 50′. ∠ D A B, 48° 12′ ∠ D B A, 92° 5′: Required the distances A C, B D, and C D.

Heights and Distances.

To find A C.

| | |
|---|---|
| As log. sine ∠ B A C, 45° 50′, | 9·855711 |
| To log. of A B, 360, - - | 2·556302 |
| So log. sine ∠ A B C, 43° 50′, | 9·840459 |
| To log. of A C, 347·6 yards - | 2·541050 |

To find B D.

| | |
|---|---|
| As log. sine ∠ A D B, 39° 43′, - | 9·805495 |
| To log. of A B, 360, - - | 2·556302 |
| So log. sine of ∠ B A B, 48° 12′ | 9·872434 |
| To log. of D B, 420, - - | 2·623241 |

To find A D.

180 — (∠ D A B, 48° 12′ + ∠ D B A, 92° 5′) = 39° 43′, or A D B.

| | |
|---|---|
| As log. sine ∠ A D B, 39° 43′, - | 9·805495 |
| To log. of A B, 360, - - - | 2·556302 |
| So is log. sine ∠ A B D, 90° 5′, or 87° 55′, | 9·999713 |
| To log. of A D, 563, - - - | 2·750520 |

To find the angles A C D, A D C.

A C, 347·6 + A D, 563 = 910·6

A D, 563 — A C, 347·6 = 215·4

180° — (90° 20′ — 48° 12′) = 137° 52′, or ∠ C + D.

$$\frac{137^\circ\ 52'}{2} = 68^\circ\ 56'$$

| | |
|---|---|
| As the sum A C + A D, 910.6, | 2·959328 |
| To their difference 215·4, - | 2·333246 |
| So tang. $\frac{C+D}{2}$, 68° 56′, - - | 10·414314 |
| To tang. $\frac{C-D}{2}$, 31° 33′, - | 9·788232 |

68° 56 + 31° 33′ = 100° 29′, or A C D,

68° 56 — 31° 33′ = 37° 23′, or A D C.

To find C D.

| | |
|---|---|
| As log. sine ∠ A D C, 37° 23, | 9·783292 |
| To log. A C, 347·6, - - | 2·541050 |
| So log. sine ∠ C A D, 42° 8, | 9·826631 |
| To C D, 384 yards - - - | 2·584389 |

It is evident, that, in all such cases as the above, the heights of the objects may be determined by taking the angles of elevation subtended by both at each station; and that an agreement of the heights, computed each on two bases, is an excellent verification of all the steps in the process.

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Mental.

MENTAL, any thing connected with mind.

MENTHA, mint, a genus of plants belonging to the Didynamia class. See BOTANY.

Mentz.

MENTZ, or Mayence, a territory of Germany, in the circle of the Lower Rhine, and formerly an archbishopric, is bounded on the north by Hesse and Watteravia, on the east by Franconia, on the south by the palatinate of the Rhine, and on the west by the electorate of Treves; and is about 60 miles in length, and 50 in breadth. The produce consists chiefly of corn, garden-fruits, and wines; likewise salt is manufactured, and several iron mines are wrought. The chief rivers are the Rhine, the Maine, the Jaxt, and the Lahn. Since the time of the Reformation, the countries on the Rhine and the Maine have been subject to the elector of Mentz. In consequence of the ascendency of the French in 1802, it was resolved that the electoral title should henceforth be Elector of Aschaffenburg and Count of Wetzlar.

*Mentz*, the capital of the late electorate of Mentz, and celebrated for the invention of printing, is situated at the junction of the rivers Rhine and Maine. It is remarkably well fortified, and contains some good houses, together with the cathedral, several churches, the university, and the electorate palace. Mentz underwent various revolutions prior to 1814, when it was delivered up to the allies, and garrisoned by Austrian and Prussian troops.

MEPHITIC, in chemistry, applies to any sort of noxious vapour, particularly fixed air or carbonic acid.

MEQUINEZ, a city of the kingdom of Fez, and the capital of Morocco, stands near a river of the same name, at the distance of about 80 leagues north from the city of Morocco, and is the residence of the emperor. The houses have flat roofs, and are generally well built; but, instead of windows, have only small holes open to the inner courts. The streets are narrow, unpaved, and, at times, almost impassable to foot passengers, by the accumulation of mud. But the situation of this city is rendered delightful by means of the highly cultivated fields, gardens, and plantations, beautified with various rivulets, with which it is surrounded. The imperial palace is fortified with two bastions, and the city itself is surrounded with walls. The Jews, who are very numerous at this place, have a walled and guarded suburb allotted to themselves in the vicinity of Negro town, which is likewise a walled place. The inhabitants of Mequinez are remarkably agreeable and courteous in their manners. The women are very engaging, and do not fly from Europeans, though they retire at the sight of a Moor. This city is estimated to contain a population of 110,000.

MERCATOR'S CHART, a projection of the earth's superficies on a plane, and so called from Gerard Mercator, a Flemish geographer, who first published maps upon the principles laid down by Edward Wright. As a proof that the ancients contemplated the importance of the construction of a chart of the world on a plane with right lines, on which any part of the world might be distinctly marked, according to its latitude, longitude, and distance, the first hint of such a thing was made by Ptolemy about 2000 years ago. See GEOGRAPHY and NAVIGATION.

MERCHANT was formerly applied to every buyer or seller of goods, such as shopkeepers, and those attending fairs or markets; but the term is now chiefly restricted to such as buy and sell extensively, and in the gross, who traffic either by importation or exportation, and who deal in exchanges. See COMPANY.

MERCIA, one of the seven kingdoms founded by the Saxons in England. It was bounded on the north by the Humber and the Mersey, on the east by the sea and the territories of the East Angles and Saxons, on the south by the river Thames, and on the west by the Severn and Dee; and it comprehended about seventeen of our modern counties. See BRITAIN, and HEPTARCHY.

MERCURY. See CHEMISTRY and GEOLOGY.

MERCURY, in heathen mythology, the son of Jupiter and Maia, the daughter of Atlas, and the constant messenger not of his father only but of all the gods. He was likewise considered the inventor of letters and god of eloquence, merchandise, and robbers. The poets describe him as a fair, beardless youth, having a smiling countenance, lively blue eyes, and flaxen hair; and he is represented with wings attached to his cap and sandals, and having in his hand a staff, surrounded with serpents, with two wings on the top of it. Likewise a purse was emblematical of his being the god of gain. The dog, goat, and cock were sacred to him, and such as escaped remarkable danger sacrificed to him a calf, with milk and honey. See HERMES.

MERCURY, the smallest of the inferior planets, and the nearest to the sun. See ASTRONOMY.

MERCY is that ennobling virtue which inspires man with sympathy towards every object of compassion. The mercy of the Divine Being is that essential perfection which inclines him to pity and relieve the miseries of mankind, and implies a tenderness and earnest desire to save, and an unwillingness to punish.

MERCY-SEAT, or PROPITIATORY, in Jewish antiquities, was the covering of the ark of the covenant, consisting of gold, and having two golden cherubims fixed at the two ends. These cherubims seemed by their extended wings to form a throne for the Majesty of God, who is in scripture represented as sitting between the cherubim, the ark being as it were his footstool.

MERGUS, a genus of birds of the order Anseres.

MERIDA, an ancient town of Spain. See ESTREMADURA.

MERIDIAN, from the Latin *meridies*, mid-day, is a verticle circle passing through the poles of the world. The meridian of any place on the earth is a great circle passing through that place and the poles. See GEOGRAPHY.

MERIONETHSHIRE, a maritime county of North Wales, bounded on the north by Caernarvonshire and Denbighshire, on the east by the latter and Montgomeryshire, on the west by the Irish sea, and on the south by Cardiganshire; extends about 43 miles in length and 38 in breadth, and contains an area of 442,240 acres. It consists of 23 parishes, has four market towns, and sends one member to Parliament. This country presents a fine diversity of wild and romantic scenery. The mountains are numerous and sterile, but the valleys afford pasture for great flocks of horned cattle, sheep, and goats. The height of Cader-Idris is inferior only to that of Snowdon, the loftiest peak being estimated at 2850 feet above the level of Dolgellan, a town situated near its base. Besides the Dee, which proceeds from several springs on the declivity of the lofty Aran, and forms different beautiful cataracts in its course, the Maw or Mawddach, the Dovey or Dyssi, and the Glaslyn and Dyrwhydd, are the chief rivers; and a mong the principal lakes are the Llyn-tegid and Llyn-Tallyllyn at the foot of Cader-Idris. The mountains of Merionethshire are chiefly composed of granite and porphyry, while the secondary hills consist of mixed schistus. The climate is rather cold, and the soil generally rocky. Woollen cloths, stockings, and gloves, are the principal manufactures. The population is nearly 31,000.

Mermaid.

Mermaid.

**MERMAID** or MERMAN, a marine animal, supposed to participate in the upper parts of the human form, but to have a tail like that of a fish. It has been the subject of much conjecture, not to say controversy, for it does not appear to have ever come under the cognizance of any well informed naturalist; and whether such a creature does actually exist, is a question which has yet to be satisfactorily ascertained. But though a reasonable degree of scepticism on the subject may not be inadmissible, the possibility of the existence of such an animal is by no means to be absolutely negatived. The reality of the great sea serpent was much questioned, until one appeared on the British shores; and it is only of late years that the doubts of naturalists have been obviated respecting the giraffe and hippopotamus. With the view of instituting a genus which should embrace the mermaid, Artedi, in his *Bibliotheca Ichthyologica*, suggests these characteristics, SIREN, Dentis—*Pinnae duae tantum in toto corpore. Cauda pinnata nulla. Caput, collum et pectus ad umbilicum usque, humanum specium habent*; and he at same time expresses a desire that some skilful ichthyologist would examine this animal to ascertain whether it be imaginary or a real fish.

The natives of those countries that border on the sea, have generally admitted the reality of sirens, tritons, and nereids, as described by the ancients; but the various accounts of the mermaid or merman are not of such a tendency as to excite a decided belief in the existence of that animal. Different individuals vary materially in their testimonies respecting the mermaid, some stating that it is hairy, others smooth, and a third party that it is covered with scales.

It would appear that the mermaid is confined to no particular quarter of the globe. In Whitbourne's *Discourse of Newfoundland*, mention is made of one which swam towards the narrator, "looking cheerfully, as if it had been a woman. By the face, eyes, nose, mouth, chin, ears, neck, and forehead, it seemed to be so beautiful, and in those parts so well proportioned, having round about the head many blue streaks resembling hair, but certainly it was not hair." In the 11th Vol. of the *Phil. Trans.* for 1676, an animal is described as having been seen by an English surgeon within about three leagues of the river Rappahannock in America. At the distance of half a stone throw, it seemed "a most prodigious creature, much resembling a man, only somewhat larger, standing up in the water with his head, neck, shoulders, breast, and waist, to the cubits of his arms above water; his skin was tawny, much like that of an Indian; the figure of his head was pyramidal and sleek without hair, his eyes large and black, and so were his eye-brows; his mouth very wide, with a broad black streak on the upper lip, which turned upwards at each end like mustachios. His countenance was grim and terrible. His neck, shoulders, arms, breast, and waist, were like unto the neck, shoulders, arms, and waist of a man. His hands, if he had any, were under water. He stood with his eyes fixed for some time, and afterwards dived down, and a little after rose at a somewhat greater distance and turned his head towards me again, and then immediately fell a little under water, that I could discern him throw out his arms and gather them in as a man does when he swims. At least he shot with his head downwards, by which means he cast his tail above the water, which exactly resembled the tail of a fish, with a broad fin at the end of it."

Pontoppidon, in the second vol. of his *Natural History of Norway*, endeavours, perhaps not without considerable credulity, to establish the fact that the mermaid or merman does really exist. "Were it possible," he says, "that the sea could be drained of its waters, what incredible numbers, what infinite variety of uncommon and amazing sea-monsters would exhibit themselves to our view, which are now entirely unknown;" and he further suggests, that the doubts regarding the existence of the animal in question chiefly arise "from the fabulous stories being generally mixed with the truth." The same author affirms, that hundreds of persons of credit and respectability in Bergen had positively witnessed the mermaid; and that, in 1723, three fishermen declared on oath that they had seen a mermaid within about eight fathoms, which had strong limbs, broad shoulders, and a coarse and hairy skin.

A belief in the mermaid is somewhat prevalent among the inhabitants of the northern coasts of Scotland. In 1797, Mr Munro, schoolmaster at Thurso, affirmed having seen a figure on a rock at Sandside-head, in the parish of Reay, which had thick light brown hair descending to its shoulder, and but for the exposed situation it occupied might have been taken for a woman. Another is said to have been observed on a black rock a few miles to the southward of Campbelton, by a peasant, in 1811; and so recently as 1819, one, having the aspect of a young girl, with prominent bosom, full dark eyes, and a profusion of long brown hair, is said to have been seen on the coast of Ireland.

It were easy to enumerate stories, many of them sufficiently ridiculous, respecting this mysterious animal, but the instances now quoted may suffice. Inaccuracy of observation, as well as a degree of misguided zeal, is perhaps apparent in the statements of most individuals who have identified marine animals observed by them as being the mermaid or merman. It seems not a little probable, too, that different species of seals may have been taken for the suppositious animal; and indeed this idea is not a little confirmed by the factitious specimens which have frequently been imposed upon the credulous by the artful and designing. Had there been such creatures, it is not to be believed but that, at one time or other, some of them, either dead or alive, must have been obtained and examined, so as to terminate every dispute respecting their actual existence. At all events, the most respectable naturalists of the present day do not seem to admit the existence of the mermaid. In conclusion, it may be remarked, that the sea-ape or *manatus siren* of modern naturalists, has been not unaptly considered as the prototype of the mermaid, concerning which so many marvellous narrations have from time to time appeared in newspapers, magazines, and other works of a similar kind.

**MEROPS**, a genus of birds of the order Picæ.

MERSEY, a river of England, which rises at the north extremity of the Peak in Derbyshire, and, being augmented in its course by other rivers, runs through the counties of Lancaster, York, and Chester, and falls into the Irish sea at Liverpool. The whole extent of this river is about 50 miles; and it is navigable for large vessels from Liverpool to the mouth of the river Irwell, a distance of 35 miles. The Mersey likewise communicates with the Dee, Ribble, Ouse, Trent, Derwent, Severn, Humber, Thames, Avon, and other rivers, by means of inland navigation. It affords excellent salmon, and is visited by annual shoals of smelts, which are esteemed for their size and flavour.

MERTHYR TYDFIL, a considerable market town of Glamorganshire in Wales, and a place of great antiquity; is in a flourishing condition by means of its iron works; and contains, besides the parish church, a spacious chapel, and about eleven meeting-houses, belonging to the Baptists, Independents, and other dissenters. Three market places are well supplied on Wednesdays and Saturdays, and several annual fairs are regularly held in it. The inhabitants, who are chiefly Welsh, are estimated at 17,000. The productions of this town are conveyed by means of a canal, which is navigable as far as Cardriff for vessels of 300 tons. It is supposed that from 180 to 200 tons of iron a-week are obtained from the mines in the vicinity; and perhaps more extensive iron-works are not to be found in Europe.

MESN, or Mesne, in law, denotes the lord of a manor, holding of a superior lord, but who himself has also tenants holding of him. The term likewise signifies a writ where there is a lord, mesn, and tenant, and where the tenant, being distrained for services due from the mesn to the superior lord, is entitled to have judgment to be acquitted or indemnified by the mesn lord, or, if he makes default therein, he shall be forejudged of his mesnality, so that the tenant shall in future hold of the lord paramount himself.

MESOLABE, or Mesolabium, a mathematical instrument, composed of three parallelograms moving in a groove to certain intersections, and anciently used to ascertain two mean proportionals between two given right lines. It is described by Pappus and Eutocius.

MESOPOTAMIA, an ancient province of Asia, between the Euphrates and Tigris, and bounded on the east by Assyria, on the north by Armenia, on the west by Syria, and by Arabia Deserta on the south. It is in Scripture called Padan-aram, and Aram Naharam, or Aram of the two rivers, and is mentioned as the first dwelling of men both before and after the deluge, and as the birth place of Abraham and many of his descendants.

MESPILUS, the medlar, a genus of plants belonging to the Icosandria class. See BOTANY.

MESSENGERS, those public officers employed under the orders and direction of the secretary of State. They are constantly in waiting to carry all kinds of foreign and domestic dispatches; and are duly authorized to apprehend persons for treason or other state offences, whom they generally detain at their own houses. Twenty of these officers are thus distributed; four at court, ten at two Secretaries' offices, two at another for North Britain, three at the Council-office, and one at the Lord Chamberlain's of the household. Messengers of Exchequer are four in number, who attend as pursuivants, and carry the Lord-Treasurer's letters and precepts. Messenger of the press is one who, by order of the court, searches printing-offices, bookseller's shops, and the like, for the discovery of the printers or publishers of seditious books.

MESSENIA, a country in the south of the Peloponnesus, between Elea and Laconia, celebrated for the resistance made by the Messenians against the Lacedemonians.

MESSIAH, a term applied in Scripture to the kings and high priests of the Jews; likewise to the patriarchs and prophets who were denominated the Messiah, or the Lord's anointed. But this term, which the Jews chiefly appropriated as a title of the highest dignity to their expected great deliverer, the Christians have applied to Jesus Christ, in whom were accomplished the prophecies relating to the great Messiah. See RELIGION.

MESSINA, an ancient city and sea-port of Sicily, situated in the north-east extremity of the island, is about five miles in circuit, contains a citadel and several forts, and is the see of a bishop. In the centre of the port are situated a light-house and a lazaretto. Messina is paved with lava, and contains many spacious buildings, and numerous churches and convents. The cathedral is a splendid Gothic edifice; and in a square in front of it is an equestrian statue, in bronze, of Charles II. of Spain. The largest of the squares is that of St John of Malta, in the middle of which is a highly ornamented marble fountain; and through the square of the Great Hospital rushes the Porto delle Legni, a considerable torrent, which proceeds from the mountains on the south side of the city. The palace and senate-house are elegant structures, and the public hospital is capable of accommodating several hundred patients. Silks are the principal manufactures of Messina, and the environs are productive of fruits and wines. This place carries on considerable trade. Carpets, silks, cotton, timber, drugs, fruits, and other articles, are brought to it from the Levant; and the exports consist chiefly of hides, goat-skins, and mottled soap, together with dried fruits, lemons, oranges, and manna. The population is estimated at between 80,000 and 90,000, and the coral and other fisheries occupy a portion of the inhabitants. The harbour is remarkably convenient, and has a quay above a mile in length.

This city suffered dreadfully from the plague in 1743, and was visited by repeated shocks of an earthquake in 1783, which effected its destruction, though not more than 800 or 900 lives were lost, the inhabitants having had time to quit their houses, during the shocks, before they fell. The ruins have been removed, and new structures are erected in their place.

MESSUAGO, MESSUAGIUM, a law term, signifying a dwelling-house, with the portion of land assigned to it; also a garden, shop, mill, cottage, cellar, and the like; but, in Scotland, it denotes the the manor-house, or principal dwelling.

Meta.

META, a pile of pyramidical stones in the Roman circus, forming the boundary of the chariot course. The metæ were first formed of wood, and afterwards of stone; one of them was placed at the entrance of the circus, and the other at the end of it. Great nicety was observed in passing the meta, so as to come as near to it as possible, without endangering the chariot. The race was concluded when the meta was passed the seventh time.

# METALLURGY.

Definition.

METALLURGY denotes the various processes by which metals are separated from their ores, or, in a more extended sense, the whole art of working metals from the state of ore to the utensil. Under the articles CHEMISTRY and GEOLOGY, the peculiar properties and combinations of metallic substances, as well as the different states in which the ores are distributed, have been already detailed. Besides the two grand operations of using the ores, namely, assaying and smelting, we shall now give some description of the furnaces employed in the different branches of Metallurgy, and likewise of the foundery, or art of casting metals into different forms.

## SECT. I. *Of Assaying and Smelting.*

Assaying.

*Assaying*, in its fullest import, comprises the peculiar methods of examining every ore, or mixed metal, with the most approved fluxes, in order to discover what quantity of metal may be obtained from each. The term is, however, usually restricted to the manner of ascertaining what portion of the precious metals is contained in alloys of gold or silver. This art, therefore, is more especially the province of goldsmiths and coiners, for trying the purity of the gold and silver used in the manufacture of plate, or in the coining of money. In the mint, the business of assaying is assigned to a proper officer called an assay-master, or king's assay-master, whose duty it is to make a fair report of the quality of the metals submitted to his examination. The assay-master of the Goldsmith's company, of London, is appointed to survey, assay, and mark all the work committed to him. In Edinburgh, the corporation of Goldsmiths elect two assay-masters out of their own body, who are sworn to do justice to the public.

Before metals are reduced to a state of fusion they are carefully assayed, to bring them to a due degree of fineness; and after metals are struck, they are again assayed to prove that they are of a proper standard. Great care is requisite in performing the assays of gold or silver alloys, which is usually done on a small scale. As plate must necessarily be assayed previously to its being stamped, it is for that purpose taken to the assay-master, who scrapes off a small portion to serve for the assay.

An intimate acquaintance with metallic minerals, and also with the general characters of the ores, proper and improper, allied to each metal, is obviously indispensable to enable the assayer to proceed with the operations connected with his business. Metals being unequally distributed in their ores, much inaccuracy would ensue were not every precaution observed that the proportionable quantity of metal produced by an assay may approach nearly to the medium quantity contained in the whole ore. This requires the operation of *lotting*, which consists in taking pieces of the mineral from the several veins of the mine, and shaking them with their matrices together; then taking of the compound a convenient quantity for the assay. The weights used by assayers consist of a peculiar set, and tables of them are to be found in the different works on Assaying, especially that of Schlutter translated by Hellot. Regarding the proportion of the precious metals allowed for an assay in this country, it is from six to twelve grains of gold, and from eighteen to thirty-six grains Troy of silver. In France, the allowance of gold is the same as in Britain; but in Germany it is three times as much.

To promote the fusion of metallic ores, the alkalies, nitre, borax, tartar, and common salt, are used as fluxes; and the more refractory the ore is, these fluxes are the more freely mixed with the assays. The black and white flux are of particular service in metallurgy. Equal parts of nitre and tartar mixed together, and detonated in a red hot crucible, yield the compound denominated *white flux*, which is a mixture of pure potash with the carbonate; and when one part of nitre, and two parts of tartar, are treated in a similar manner, the result is a mixture of potash and charcoal, called *black flux*, in reference to its black colour.

As in the process of pulverization some of the ore must unavoidably be lost, it should be reduced to a gross powder, fit for roasting before it is weighed; and most ores being disposed to crackle and disperse when first heated, the ore, when roasted, should be covered with an inverted test. For the perfecting of the fusion, a due degree of heat must be applied; and this accomplished, the crucible ought to be struck occasionally, to facilitate the disengagement of the parts of the regulus from the scoria, and likewise to promote their descent and union into a single button of metal. Till the contents of the crucible become perfectly cold they should not be examined, nor the crucible broken. The fusion is known to have been good if, upon breaking the crucible, the scoria be neat, compact, and equal; if it have not penetrated or overflown the crucible; if it contain no metallic grains; and if its surface be smooth and hollow in the middle. The regulus being found well collected, without holes or bubbles, and having a neat convex surface, is next separated from the scoria, duly scraped and cleaned, and, finally, weighed. Provided the operation have been carefully done, from the weight may be deduced what quantity of metal will, in the great, be obtained from every real quintal of ore; though, however judiciously the assays may have been accomplished, some small differences are unavoidable. But by thus ascertaining the medium of the results of the operations, the true product of the ore will as nearly as possible be approached. In this country, two assays of the same mass of metal are uniformly made for the mint; and between the weights of the buttons no sensible difference is allowed in scales that turn with the $\frac{1}{1200}$ part of a grain Troy.

Different methods are adopted in refining silver and gold, according to the metals with which they are combined; but the process of *cupellation*, already noticed in the article Chemistry, is most commonly had recourse to. Though gold is not oxidated by air and heat, the metals, silver excepted, with which it is alloyed, pass at a high temperature into the state of oxide, which, in reality, constitutes cupellation. The oxidation is however incomplete when, in comparison of the gold, the base metals are in small quantity; whereas the oxidation of the base metals, as well as their separation, is effected by the addition of a metal that is easily oxidated. This metal is lead.

The method of separating gold or silver from the other metals being found to depend upon the facility with which oxygen is imbibed by the latter, oxide of lead is employed to accelerate the process satisfactorily, and, moreover, because of the peculiar readiness wherewith it parts with its oxygen to the imperfect metals. But metallic lead is always used in the assays made by authority, owing to the supposition that it tends to facilitate the determining of the weights of the different ingredients. From the experiments instituted by Hellot, and others, it appears that the quantity of lead, added to the alloys of silver, may be properly stated as follows:—

1 copper 3 silver, require 40 of lead.
1 - 5 - - 48
1 - 23 - - 96;

and for gold the proportion is nearly the same. Some assayers, however, recommend a smaller quantity of lead for alloys, both of gold and silver.

In assaying these metals they are first separated from the imperfect ores, and afterwards parted from such as resist oxidation, and are thence denominated perfect metals. This latter operation consists in the parting of gold and silver from each other. The operation of parting is accomplished by the action of nitric acid, which dissolves the silver, leaving the gold unaffected; but if the latter exceed a certain proportion in the mixture, its influence is to protect the silver from the acid, so as to prevent its action in a greater or less degree. When the gold, therefore, is in excess, as much silver must be added as will give the predominance to this metal. It has been usual to allow the proportion of three parts of silver to one of gold, though two parts are thought enough by some respectable assayers. Copper as well as silver being soluble in nitric acid, the parting process may be proceeded with when both these metals are present; but it is advisable, first, to cupel the compound with lead, and that even in the absence of copper. The baser metals may be separated from gold by the process of cupellation, in the same manner as from silver; yet such is the affinity of copper for gold that it can scarcely be separated, if with the mass there be not a due proportion of silver combined.

By means of sulphuret of antimony, gold is sometimes freed of the baser metals, because the sulphur, while it does not combine with gold, has a less attraction for antimony than for the other metals. In some particular cases, likewise, gold is purified by *cemmentation*, that is, beating the alloy to thin plates, which are placed in alternate layers with a cement, consisting of one part nitre, two calcined green vitriol, and two of pounded tiles, formed into a paste with urine, and then subjected to heat in a furnace, and kept for 24 hours below the boiling point of gold. The metal is then boiled, first in water and then in nitric acid, to deprive it of the extranous matter.

According to the nature and combinations of an ore of silver, its analysis is varied. Native silver being pulverised and sufficiently washed, is rubbed and strongly triturated with liquid mercury. The amalgam thus formed being subjected to pressure, to separate the excess of quicksilver, is distilled and afterwards heated in a crucible, in order to volatilize the mercury. If sulphur and antimony be combined with silver, the ore must be strongly roasted to promote the separation of these substances. The sulphuretted oxide is treated in a similar manner, when the silver remaining is fused with a portion of alkaline flux. But the process of cupellation is essential for silver as well as gold, for the purpose of obtaining the metal in a state of purity.

On the alloys of platina, nitrous acid has a powerful effect. In this acid platina itself is equally insoluble with gold, and its action is likewise resisted by these two metals in combination; but if into the mixture silver be introduced in the proportion of two and a half or three times the weight of the gold and platina, while the latter is not more than a tenth of the former, the platina and silver are dissolved and the gold remains. With platina silver is rarely alloyed; but its more frequent combination with gold is discerned from the superior heat necessary in fusing; the edges of the button appearing thicker and more round than usual, the colour being dull and tending to yellow, and likewise from the crystallized surface.

*Smelting* consists in the fusing of metal from the ore in a furnace, so as to separate the metallic parts from the sulphur and arsenic, and the earthy and stony substances of all kinds combined with them. Properly speaking, the term applies only to extensive works in which ores from the mines are melted down and separated. Several processes, suggested from a knowledge of the peculiar properties of the different matters connected with the metals, are found effective in separating them in the large way. From the earth and stones adhering to the ore, it is first to be parted; and this may be done by mechanical means, when the extraneous substances are in a considerable mass, and not closely mixed with the ores in small particles. The adhering substances, however, are not unfrequently found efficient as a flux. When the metallic earths are intimately connected with the ore, it must be broken and reduced into particles,—an operation generally accomplished by means of a proper machine which moves pestles, denominated *bocords* or *stampers*, and thus bruises the matrice to gross powder. The separation of the earth or stone is next effected, if the earth be specifically more heavy than the extraneous matters, by the operation of washing.

Little or no previous roasting is necessary to promote the fusion of the matter, if it happen to be of a fusible nature; for the retention of a large portion of the sulphur operating with the fluxes, thus converts into scoria much of the stony part of the mineral, while the rest is reduced into a brittle substance called the *matt*. In this substance, which constitutes an intermediate matter betwixt the mineral and the metal, much less useless or foreign matter is combined than was concentrated in the ore. But the matt being of a sulphureous nature, the metallic properties are therefore not possessed by the metal it contains, which must consequently be several times roasted to effect the evaporation of the sulphur previous to the melting of the metal, when it is desired to have it pure. The pyritous matters adhering to the ore can scarcely be pulverised, owing to their great tenacity; and in this case the ore must be roasted in whole or in part, and then thrown red into cold water, that it may with the greater ease be reduced to gross powder.

Treating the ore with a gentle heat is called *roasting* it. For this operation Schlutter suggests five methods: 1st, To construct a pile of ores and fuel, placed in alternate strata in the open air, without any furnace; 2d, To confine such a pile within walls, but without a roof; 3d, Placing the pile under a roof without lateral walls; 4th, Placing the pile into a surface consisting of walls and a roof; 5th, Roasting the ore in a furnace wherein it must be constantly stirred with an iron rod. The fusion of an ore not roasted, or that is roasted in part, is denominated *crude* fusion. Arsenic being more weighty than sulphur, and nearly of the weight of metals, the ores are in general remarkably heavy in which it prevails, and may on that account be washed with comparative ease. Yet disadvantages occur in the roasting and fusion, considerable loss being occasioned by means of the arsenic, which has the power of volatilizing, scorifying, and destroying many of the metals, and which, moreover, when exposed to a violent heat, will scarcely separate by intense forcing.

The workmen usually pile the ore into heaps with fuel, in order that the whole may become red hot, and the air, at the same time, have free passage through it. Copper, and other ores, require several repetitions of the process, in consequence of the arsenic and sulphur adhering very tenaciously. The metal, by means of this operation, remains more or less in the form of an oxide, and therefore its reduction is rendered the more essential. Earths are sometimes necessarily added to the ores, as they are found to contain some which, though of themselves not very fusible, are capable of fusibility by their union with others. In consequence of the fires being for some time kept up, the ore gradually melts, and as it passes through the fuel, which usually consists of charcoal of wood, the oxygen which the oxide contained is carried off by means of the affinity of the charcoal, while the metal falls into the bason which is constructed in the furnace for the purpose. In this manner, consequently, the metal is obtained free from extraneous matters, though some other metal is unavoidably still combined with it. Besides arsenic, a number of ores contain antimony, zinc, and other volatile semi-metals, these being neglected, owing to their untractableness, in reference to which they are called *mineræ rapaces*, or rapacious metals.

According to the quality of an ore, and of the matrice to which it adheres, particular fluxes are to be applied. Not unfrequently the matrices of two ores of the same metal are found applicable as fluxes to each other. Thus an argillaceous matrice serves with a matrice that is calcareous, because both are disposed to vitrification when intermixed, though individually they are of an infusible nature; and, therefore, two or three ores that require smelting, are usually, with great advantage, mixed together. Different fluxes are essential for the ores of different metals, but those most generally in use for the smelting process are calcareous earths, fluors, or vitreous spars, quartz and sand, fusible stones, such as slates, basalts, together with the various kinds of pyrites and scoria.

Calcareous earth is found to be best adapted for ores of iron, and spars and scoria for fusible ores of copper. Quartz is at times added in the fusion of ferruginous copper ores, with the view of promoting a greater heat in the ore, and likewise giving a more perfect vitrification to the ferruginous scoria. By means of sulphur and pyrites, the fusibility of the scoria of metals is greatly aided. To induce the fusion of all calciform and calcined ores, charcoal, or other fuel, is necessarily added; and the precipitation of valuable metals is frequently much assisted by the addition of some that are inferior. Magnetic iron stone, as well indeed as the other ores of iron, are, when broken down, melted by means of a mixture consisting of one part charcoal, six chalk, and eight bottle glass. This flux, of which a portion double the weight of the ore must be used, is exposed in a blast furnace to an intense heat for the space of about an hour, when the metal is found at the bottom of the crucible. If much calcareous matter be contained in the ore, the proportion of chalk may be diminished; and if very little earthy matter be combined, charcoal of itself may suffice.

Of all the metallurgic operations, the most important, and that to which the greatest attention of the miner is directed, is the act of fusing the ores after they are roasted, as by this is realized the advantageous product which he naturally anticipates. On a cursory view, this process appears extremely simple; yet though, in general, it consists merely in fusing the roasted ore for the extraction of the metal, it differs so much, notwithstanding, in respect of the peculiar nature of the metal and the ore to be treated, the furnaces employed, the quantity and nature of the fuel, the energy, duration, and administration of the fire, the addition of a proper flux, the time and method of casting the fused metal, and other circumstances, that not a little judgment and caution are necessary to the undertaking.

Furnaces.

Furnaces.

## Sect. II. *Of Furnaces.*

A furnace is a building or vessel, or other apparatus, for containing combustible materials, and for producing and concentrating a due degree of heat. The requisites of a good furnace are, the concentration of the heat and power of directing it to the substances to be acted upon; to prevent its dissipation; to obtain the greatest quantity from the smallest quantity of fuel; and to have it under such management as to regulate at pleasure the necessary degree of heat. Furnaces are obviously among the most indispensable instruments in chemical or metallurgical operations, and are necessarily constructed of such materials as will resist the heat to which they must be subjected. They are, therefore, usually formed of bricks consisting of sand and clay, or of cast-iron or iron plates, and coated in the inside with Windsor loam, to the thickness of about an inch. For the purpose of small experiments, different fire-proof furnaces may be prepared of black-lead crucibles. In furnaces, combustion is kept up by means of a natural current of air, occasioned by the fire itself, as in an air-wind furnace, or through the influence of compressed air, communicated by large bellows, as in a blast furnace.

In order, as much as possible, to confine the heat to the matter to be acted on, the fire is commonly situated in a chamber constructed on purpose, and provided with a door for putting in the fuel, and a grate for its support, as well as for allowing air to pass through, and the ashes to drop down into the cavity called the *ash-pit.* The dissipation of the heat must likewise be prevented; and this is done by closing the door of the furnace, observing, at same-time, that the width of the chimney be not too great, and that the substance to be operated on be so placed that the fire, in ascending, may have the desired effect. Another purpose, namely, the production of the greatest quantity of heat from the smallest quantity of fuel, is sufficiently worthy of attention. This is a difficult matter, depending upon the proportion between the space betwixt the furnace bars and the width and height of the chimney, as appears evident from the peculiar principles on which are produced the degrees of inflammation. Thus, when the fuel is set on fire, a degree of heat is the consequence, though the combustion would inevitably cease were a regular influx of air not admitted among the fuel; but this being done, a rarefaction is occasioned in the air of the fire-place of the furnace, which air (a constant flow being continued) is impelled up the chimney. Heat is evidently increased proportionably to the rarefaction of the air in the fire-place, yet the necessary precautions should be taken to prevent its being spent to no purpose on the chimney. For this end, the occasional contracting of the throat of the chimney with a sliding plate is the remedy usually resorted to. In furnaces where no great heat is required, this sliding plate may consist of cast-iron, but for others fire clay is generally preferred; while for those wherein very considerable quantities of metal are fused, and an immense waste of fuel occasioned, the contrivance is found inexpedient, and is consequently not applied. Where, however, the thing can be turned to advantage, it is advisable, as an abridgement of trouble, to put in at once a large proportion of fuel, which will consume slowly, requiring very little attention.

A fourth consideration in regard to furnaces is, the due regulation of the heat; and, for this purpose, according to Dr Black, it is necessary to have the command of the furnace below, the parts above being frequently filled with small quantities of soot. To effect this in the best manner, the door of the ash-pit should be perfectly close shut up, and should have a set consisting of seven or eight circular holes, bearing to each other a certain proportion, their areas being as 1, 2, 4, 8, 16, &c. In order to promote the greatest increase of the fire, the passages above and below are thrown open, and the vent at same time augmented in height; by which means the height of the column of rarefied air accelerates the motion of that through the fuel, and the heat of the furnace likewise. The application of another tube to the ash-pit has been suggested by Mr Macquer, with the view of increasing the current and velocity of the air, by its being directed from a wider into a narrower vent; but this can be of use merely where the furnace occupies a room of small size, and where the tube itself communicates with the air externally. In its formation this auxiliary tube is widest at the end farthest from the furnace, to which it tapers gradually.

Plate 39. in connection with the article Chemistry in this work, represents views of the furnaces belonging to the Surrey Institution, London.

A small furnace, called a forge, is employed by smiths and other artificers in iron and steel, for the purpose of bringing the metal to a red heat, and rendering it more malleable and easy of working on the anvil. This usually consists of a pair of bellows, having the nozzle directed to a smooth area, whereon coals are laid. To the bottom of any furnace may likewise be directed the nozzle of a pair of bellows, so as to increase the combustion of the fuel there placed; and thus a kind of forge is prepared. There is commonly, in laboratories, a small furnace, of a cylindrical form, open at top, and having a hole in its lower side for admitting the nozzle of a double bellows. Two inches above the hole, in the lower part of this furnace, may be placed an iron plate of equal diameter, raised on two horizontal bars, and pierced with four holes near its circumference, and exactly opposite to each other. Now, the wind of the bellows being impelled beneath this plate, and finding entrance by the four holes, an equal distribution of heat is the consequence. In the forge furnaces for melting copper, which are of a square form, advantage is taken of this contrivance. It is obvious, that while the forge is unsuitable in cases where heat is required to be gradually increased, it is, on the other hand, peculiarly convenient when a great heat is to be quickly applied; because the wind of the bellows very powerfully excites the action of the fire. In forging ores, metals, and the like in small, the forge or blast of bellows is found remarkably useful. The next object of attention, according to our arrangement, is the foundery.

## Sect. III. *Of the Foundery.*

By the term foundery is implied the workhouse or smelting place wherein metals are cast into proper forms, and also the art itself of conducting the various operations. Under this head may be detailed the different processes connected with this branch of metallurgy in the following order: 1. The foundery of small works, or casting in sand; 2. Of statues; 3. Of bells; 4. Of great guns and mortars; and, 5. Of printing types.

1. *Foundery of small works.*—For the purpose of casting small works, founders prepare their moulds of a kind of moist and tenacious sand, which, though yellowish at first, becomes at length of a black colour by means of charcoal dust, which is necessarily strewed in the mould, and also by the action of the red-hot metal. To free the sand from all hard lumps or pieces of stones, and to qualify it sufficiently for use, it is well wrought on a board by means of a roller and a sort of knife, while a chest or trough is placed under the board for its reception, when thoroughly prepared. After this process a smooth wooden board is taken, the dimensions of which accord with what is designed to be cast, and the first half, if an open mould or frame of wood, being placed upon it, and within this, again, the proper models, consisting either of wood or metal, it is then filled up with sand, so moistened that it may adhere in a sufficient manner; and, further, that the impressions from the models may be duly obtained, the sand is, by means of a roller, carefully pressed upon them. This being accomplished, the next business is to effect, by means of half a small brass cylinder laid along the middle of the mould, a canal through which the metal is to run, and from which some others are to extend to each pattern in the frame. The other half of the mould, wrought in a similar manner, is now placed over the one containing the patterns, so as to enable the pins to enter into the corresponding holes in the other, when the workmen commence working it with the view of causing the two cavities of the model to fall on each other. By this method of procedure, both frames of the mould are prepared; and after their backs are smoothed by scraping, the patterns are gently loosened all round, and thus extracted without causing the sand to crumble down. This mould being afterwards taken to the melter, he extends the main canal of the counter part, adding, at same time, the cross canals to the models in both; and then, preparatory to the process of drying in a proper oven, he strews over them some mill dust. The two frames being dried, are joined together by means of the pins, and likewise screwed or wedged up in a couple of wooden screws, that the fused metal may not, in running through the chief cylindrical canal, cause them to go asunder; and thus the moulds are rendered perfectly ready for use.

In preparing the metal, a crucible is used of sufficient size for containing what metal is proposed to be cast. The fused metal being brought to a state of proper heat, is, through the mouth of the chief canal, poured into the moulds, which are then allowed to cool. All that now remains to be done is to take out the cast-iron work, having first unscrewed the frames. For the purpose of assisting in other castings, the sand is again moistened and wrought in the manner already described.

2. *Casting of statues.*—In this branch of art, the primary objects of consideration are, the preparing of the pit, the core, the wax, the outer mould, the inferior furnace for melting off the wax, and the upper for melting the metal. A dry place being chosen, a hole, called the pit, is dug, of rather greater depth than the proposed figure, and formed relatively to the prominent parts of the same; and for lining the pit within, stone or brick is usually employed. This pit serves for figures of ordinary size; but for very large figures the operations are sometimes performed more conveniently on the ground, by raising a fence qualified to resist the force of the metal in a state of fusion. To a rude mass, called the core or inner moulding, the proper attitude and contours are communicated. This mass, the purpose of which is to support the wax and the shell, and lessen the weight of the metal, is commonly a preparation of potter's clay with hair and horse-dung, or of plaster of Paris and brick-dust. It is elevated on an iron grate of sufficient strength, and supported within by means of a number of iron bars. An aperture being left in the brass figure, the superfluous iron bars, together with the core, are thereby afterwards taken out, when it is soldered up, and such only of the bars as serve to steady the projecting part within, are allowed to continue.

Of the proposed statue the wax is a representation, and it should be all of the artist's own hand, if a piece of sculpture be the object in view. Though the wax is generally formed in the core, it may be wrought apart in cavities, moulded on a pattern, and subsequently arranged on the ribs of iron which are placed over the grate, the space in the grate being filled with liquid plaster and brick dust, by means of which the core within is properly adjusted, while the wax is adjusted by the sculptor. After the wax has been prepared of the intended thickness of the metal, small waxen tubes are set perpendicular to it from top to bottom, by way of canals, for conducting the metal to every part of the work, and likewise to give liberty to the air, which would otherwise prove prejudicial when encompassed by the hot metal. The next process is to apply the shell to the work. This is a sort of crust of a soft matter which is laid over the wax, in order to receive the impression of every part which is to be communicated to the metal when it takes the intermediate place of the wax.—According as different layers are applied, the matter of the outer mould is varied. Thus a preparation of clay and old white crucibles, ground, sifted, and duly moistened with water, usually serves for the first impression, and is, by means of a pencil, laid seven or eight times over as it successively dries; in the second composition natural earth and horse-dung are combined with the previous matter; and for the third layer, a number of thick applications of which are made, all that is used is merely a mixture of earth and horse-dung. In this manner the shell is at length completed, when it is properly secured by several girts of iron situated at due distances, and fixed below to the grate, while at top they all terminate securely in a circle of the same metal.

When, on account of the large dimensions of the statue, the moulds cannot with perfect safety be removed, they must be wrought on the spot where the cast is to be accomplished; and for this operation either of two methods must be taken. First, a pit of much larger size than the proposed mould may be dug, and lined on the inside with brick or with freestone. In the bottom of this pit a hole is formed of the same material, with a sort of furnace, having an outward aperture, and in which is prepared a fire for drying the mould and ultimately melting the wax. The grate is to be placed over this furnace, then above it the mould finished, as has been described; and, lastly, for the purpose of fusing the metal, another large furnace is made at one of the edges of the pit. The second method consists in working the mould above ground, employing, as in the first case, a furnace and grate underneath; and four walls being formed around, as well as a massive by the side for a fusing furnace, the other arrangements are similar to those adopted in the first method.

Whichever of these two methods be taken, the mould, in a state of completion, is enclosed, a proper fire is kindled in the furnace beneath, and then the whole is covered with planks. By these means the wax melts gradually down, and runs out at pipes purposely prepared at the bottom of the mould, and which are afterwards closed with earth in a careful manner. Bricks are now thrown in at random to occupy the hole, when the fire in the furnace is increased so as to render red hot both them and the mould. The next business is to put out the fire; which being done, and every thing become entirely cold, the bricks are taken out, and their place filled up to the top with earth, which is previously moistened and a little beaten. It now remains to run the metal, ready fused, into the mould.

By means of the furnace above alluded to, the melting of the metal is effected. This furnace is generally formed like an oven, and has three apertures, the first of which is designed to admit the wood, and the second to serve the purpose of a vent, while the third affords an outward passage to the metal. This latter aperture is necessarily kept perfectly close during the fusing of the metal, and from it a small tube is laid for the conveyance of the metal into a capacious earthen bason placed over the mould, and whereinto are inserted all the large branches of the casts or jets, through the medium of which all the parts of the mould are to be supplied with the metal. To prevent the metal, which flows instantaneously out on the opening of the furnace, from entering these casts or jets before a due sufficiency of it be communicated to the bason, they are terminated with plugs or long iron rods with a head at one end large enough to fill the diameter of each tube, and which are kept quite close. But whenever the bason has received enough to run into all of them at the same instant, these plugs are taken out by the workmen, the furnace is wholly opened by means of a lengthened piece of iron attached to the end of each hole, and the mould is thus at once entirely filled, which operation completes the casting department of the work. The figure is at length taken out of the mould and the earth which encompasses it; and the sculptor or carver then saws off the jets and executes all the necessary amendments.

*Foundery of bells.*—In a separate article, the form, uses, and sizes of bells have been detailed, and also the metal described which is employed in casting them. See Bell.

Considerable precision is requisite in ascertaining the proper dimensions of the core and the wax for bells, more especially for a ring of them. This measurement is made on a scale or diapason, which gives the height, due thickness for the several tones, and also the aperture. The different ornaments which are to be represented on the outside of the bell in relievo are for that purpose formed upon the wax. The proportion of a bell, the formation of the mould, and the fusion of the metal are the three grand particulars constituting the art of bell-foundery.

With regard to the first of these particulars, there are two kinds of proportions, namely, the simple and the relative, the former being those which subsist between the different parts of the bell, and tend to render it sonorous, while the latter are designed to occasion a consistent harmony between several bells. Sometimes a certain proportion is observed between the size and thickness, and in large bells the thickness of the edge is one-fifteenth of the diameter, and the height twelve times the thickness. The sound of a bell is made up chiefly of the sound of its extremity or brim, as a fundamental of the sound of the crown, which is an octave to it, and that of the height, which is a third. This circumstance arises from the height of the bell being in proportion to its diameter, as 12 to 15, or in the proportion of the fundamental sound to its major.

The *mould* of a bell is made of the following materials: 1st, Earth of a cohesive nature is properly ground and sifted, that no chinks may occur; 2d, brick-stone is employed for the mine, mould, or core, as well as for the furnace; 3d, that the cement may be rendered sufficiently adhesive, the earth is mixed up with hemp, horse-dung, and hair; 4th, wax is used for the inscriptions, coats of arms, and other ornaments; 5th, with the wax tallow is equally mixed, so that, prior to any letters being applied to the outer mould, a slight lay may be put upon it. A scaffold is elevated on four boards ranged upon tressels, to enable the workmen to proceed in constructing the mould; and here the earth grossly diluted and mixed with horse-dung is well wrought by means of a large spatula. In forming the mould, an instrument called the compasses of construction, and which consists of two separate legs joined by a third piece, is employed; and on the founder's shelves the letters, cartridges, coats-of-arms, and other symbols, are arranged. A pit is now dug deep enough not only to contain under ground the mould of the bell with the case, but also lower, by about six inches, than the terrpleins where the work is executed, and of sufficient width, moreover, to admit of a free passage between its walls and the mould, or between the moulds, when it is proposed to cast more than one. For the support of a peg of iron, on which the pivot of the second branch of the compasses turns, a stake is erected at the centre of the pit, and strongly fastened in the ground. A piece of solid brick-work, of a circular form, and called the *mill-stone,* is next erected round the stake, to the height of half a foot, and the diameter of the bell to be cast.

The mould consists of the core, the model of the bell, and the shell subsequent to the formation of its outer surface. The core is raised by the workmen in the following manner: Bricks are disposed in courses of equal height upon a lay of earth; the branches of the compasses, on which is shaped the curve of the core, are brought towards each brick as it is laid, in order that the distance of a line (to be afterwards filled up with layers of cement) may remain between it and the curve, and the work is thus continued to the top, while an aperture is left for the coals which are to bake the core. A layer of cement, made of earth and horse-dung, is now applied to the work, and properly smoothed by means of the compasses already mentioned, after which the core is subjected to the fire, it being one-half filled through an opening, which, during the baking, is kept close with a cake of earth which has been baked separately. The stake is consumed by the first fire, which, for a half, or perhaps a whole day, is left in the core, and when the first layer becomes completely dry a second, third, and fourth, are successively laid on, smoothed, and dried. When the completion of the core has been in this manner effected, the compasses are taken to pieces, with the view of cutting off the thickness of the model; but they are again put in their places for the commencement of a second part of the mould, which is constructed of a composition of earth and hair laid on with the hand in cakes that close together, and this is completed by the application of a few layers of a thinner cement of the same matter, each of them being duly smoothed and dried. A preparation of wax and grease serves for the first layer of the model, and this being spread over the whole, the next business is to apply the inscriptions and ornaments, every part of which, by the aid of a pencil, is covered with wax out of a chafing-dish.

Preparatory to commencing the shell, the compasses are taken asunder for the purpose of cutting off what wood occupies the space corresponding with the shell's proposed thickness. The earth of the first and successive layers is finely sifted; and that it may cohere sufficiently, it is, whilst tempering in water, qualified by being mixed with cow's hair. This preparation is poured slowly upon the model, filling the sinuosities of the figures, and again poured till the whole is two lines thick over the model. After the drying of the first layer, a second one, which is rather thicker, is laid on it, when the compasses are again applied, and the wax melted off the inscription by a fire being lighted in the core. After this the other layers of the shell are applied, and to the cow's hair is added some hemp. The thickness of the shell very soon comes lower than the mill-stone by four or five inches, while by its closely surrounding the mill-stone, the escape of the metal from the vessels is prevented. Previously to fusing the metal, the wax ought to be taken out. As the ear of the bell is a separate business, it is attended to while the different incrustations of cement are drying. Of the seven rings belonging to the ear, the last, which unites the others, and is also a perpendicular support for the curves, is denominated the *bridge.* For the admission of a large iron peg, an aperture is left at the top. This peg is bent at the bottom, introduced into two holes in the beam, and securely fastened with two iron keys of sufficient strength. Models are made of the rings with masses of beaten earth, which, to complete the hollow of them, are therefore dried in the fire. These rings are subjected to a gentle pressure on a layer of earth and cow's hair, whence they are withdrawn, without breaking the mould; and for 12 half-moulds, this process is 12 times repeated, that two and two uniting the hollows may be formed of the six rings, and the hollow of the bridge being formed in a similar way, they are baked by the workmen, and thus united together. The rings of which the ear consists are laid on the open place left for the admission of the coals; the iron ring for the support of the clapper being first put in, and a round cake of clay made to occupy the diameter of the core's thickness, which latter is clapped on the opening after baking, and soldered by spreading over it a thin mortar that intimately attaches the cover to the core. Moistened earth is now employed to fill the hollow of the model; and this being applied to the core several times, it is gently beaten with a pestle to a due height, while at top the earth is smoothed with a wetted wooden trowel. The hollows of the rings are gathered by the workmen on this cover, which is to be afterwards taken off. Every thing being duly arranged, the outsides of the hollows are qualified with mortar, so as to bind them with the bridge, while they are kept steady below by means of a cake of mortar that occupies all the aperture of the shell, and which is allowed to dry, so that it may not break when removed. Before the metal is introduced into the vacuity of the mould, and, with the view of affording it proper space, the hollows of the rings through which it must pass are pulled off. They now take the ear of the shell, range beneath the mill-stone five or six pieces of wood, in length about two feet, and of such depth as nearly to reach the lower part of the shell, after which wooden wedges are driven in between these and the mould to shake the shell of the model, on which it is placed, that it may with facility be drawn up when required. This, together with the wax, being removed, the workmen then break the model, and the layer of earth through which the metal must run from the hollow of the rings betwixt the core and the shell. It is found advantageous to smoke the inside of the shell, by burning straw under it, which process tends to smooth the bell's surface. The shell is then put into the place in such a manner as to leave an equal interval between that and the core; and previously to again putting on the hollows of the rings or the cap, two vents are added, which, by a mass of baked cement, are united to the rings and to each other. They then put on this mass of the cap, rings, and vent over the shell, and solder it with thin cement, which, being covered with burning coals, is thus at length dried, when the pit is filled with earth, which is strongly beaten round the mould.

The fire is confined to one place, and the metal to another. To the fire-place is attached a large chimney with an ash-hole. The furnace containing the metal is vaulted and constructed of brick, but has an earthen bottom; and of the four apertures belonging to it, the first allows the flame to revibrate, the second is closed with a stopple, which, when opened, allows the metal to run, while the other ones not only allow the smoke to escape, but also admit of the separation of the dross of the metal by means of rakes for the purpose. In order that the metal may run down, the ground of the furnace is constructed in a sloping direction.

*Foundery of Great Guns and Mortar-pieces.*—The casting of great guns and mortar-pieces is constructed in a way nearly similar to that of bells, now described. Being without any core, run massy, they are determined by the hollow of the shell, and ultimately bored with a steel trapan, which is worked by horses or by machinery. These warlike engines are formed of iron or brass, or of a compound of copper, tin, and brass, in which case the design of the tin is to add to the compactness and density of the metal; but less of it is required in proportion to the greater weight of the copper. A mixture is generally adopted of 8 lbs. brass and 10 lbs. tin to 100 lbs. copper; and sometimes likewise a compound is employed of 10 lbs. tin, 10 lbs. lead, and 5 lbs. brass. Of cannon, eleven feet in length, the parts and proportions are the barrel or cavity 9 feet, its fulcrum or support 14, and its axis 7; the diameter of the bore at the mouth, 6 inches 2 lines; the plug of the ball 2 lines, and the diameter of the ball 6 inches, and weight 33½ lbs. The thickness of the metal about the mouth of the piece is 2 inches, and at the breech 6. Of such a cannon, which will carry point blank 600 paces, the charge of gunpowder is 18 or 20 lbs. See MECHANICS, and also WAR.

*Foundery of Printing Types.*—To proceed with this branch of business, the letter-cutter being provided with the necessary tools, must, in the first instance prepare convenient steel punches in order to design on the face of them the proper shapes of the letters; which, if small, he accomplishes with the blunt point of a needle, or, if large, by means of a pen and ink; after which he sculps out the steel between the strokes, or marks with pointed gravers and sculptors, leaving at same time the marks upon the face of the punch. When the inside strokes of the letter have been carefully shapen, the hollows are to be deepened with the same instrument, which process is regulated by the depth of the counter-punch; and to render it perfectly fit for the matrice, the outside is carefully worked by means of appropriate files. But for the justifying of the matrices, a mould is essentially necessary, and it must have an upper and under part, each of them similar, excepting that, in the former, for the purpose of nicking the shank of the letter, there are a stool and a bow, or spring behind, and also a small roundish wire between the carriage and body, near the break where, in the body of the under, a small rounding groove is formed. Both these parts are adapted to fit each other, and to slide backwards and forwards, constituting what is called a male and female guage. The shank of the letter is made thicker by the sliding backwards of these two parts of the mould, and thinner by the contrary movement, and this because, in the first instance, the bodies on each part of the mould stand wider asunder, whereas, in the second, those on each part are placed together more closely. When the mould has been completed, the next business is to justify it. This consists in casting about 20 specimens of letter, arranging them with their nicks inclined to the right hand in a composing stick, and thus examining them with the pattern letter disposed in a similar way, by which comparison the measure of the body to be cast is accurately ascertained. Matters being thus far advanced, the preparing of the matrices next demands attention. These are pieces of copper or brass, in length about an inch and a half, and of proportionable thickness according to the size of the letter proposed to be cast, and whose face is sunk into it by impelling the letter-punch to a proper depth. It is then requisite to justify the face and sides of the matrice, and otherwise to sort it properly by filing, when it is taken to the furnace.

The furnace is an upright structure, composed of brick, with its four sides square, and it is covered at top with a piece of stone, wherein, for the holding of a pan, there is formed a circular hole of sufficient width. Extensive type-founderies contain a number of furnaces of this description, and in these establishments very considerable portions of the proper metal are prepared at once, and served out as required in bars of the weight of about 20 lbs. The metal is prepared in a furnace situated under a shade, and provided with a wheel-vent, the purpose of which is effectually to heat the large cast-iron pot wherein the metal is contained. The bars of lead are put gently into the pot, while the fire is kindled below; and, to expedite the fusion, a due proportion of pitch and tallow are thrown in beside it, and the flame which consequently arises being caught by the draught of an outer chimney which projects about a foot over the farthest lip of the pot, not only promotes the rapid fusion of the lead, but also carries off the disagreeable fumes. A certain proportion of pure antimony, together with stub nails ground in an iron mortar, is introduced amongst the lead while in a state of perfect fusion, and the whole is incorporated by adding some more tallow, and by laborious stirring with an iron ladle.

Numerous small cast-iron troughs being ranged on an even platform situated towards the right hand, the metal is drawn off into these troughs usually to the extent of 15 cwt.; which quantity is in one day prepared with facility in the way described.

The founder, before he proceeds to cast, prepares a fire in the furnace, and sets in the pan charged with metal to be fused; which metal must be heated in proportion to the particular letter to be formed. Thus it must be even red hot sometimes, in order to cast a thin letter with great bodies, or a small bodied letter. Being provided with a number of ladles adapted to the different purposes in view, the workman takes one of these capable of holding a sufficiency for the letter and break, and placing it to heat at the hole where the flame appears, he, with a thread, ties a thin leather that is cut with the narrow end against the face, to the leather groove of the matrice, in a sufficient manner; after which, the two halves of the mould are put together, and the matrices into the matrice cheek, while the foot of the matrice is situated on the stool of the mould, and the broad end of the leather on the wood of the upper half of the mould, in such a way, that, in a train of work, the stool of the matrice may not be prevented sinking close down on the stool. Some rosin being now laid on the upper wood of the mould, while the casting ladle is in readiness, sufficiently hot, the workman, with one side of it, melts the rosin, pressing, at same time, the broad end of the leather to the wood, so as to attach it properly thereto; and every thing being thus brought to a state of readiness, the operation of casting is to be commenced. For this purpose the under half of the mould is placed on the left hand, with the hook or hag, as it is called, in a forward direction, then the ends of its wood are seized betwixt the lower part of the ball of the thumb, and the three hind fingers, placing, at sametime, the upper half of the mould on the under half, that the male guage may fall into the female, while the foot of the matrice rests upon the stool. At this instant, the upper half of the mould being firmly clasped with the left hand thumb, the workman actively takes hold of the bow or spring with his right hand fingers at top, and his thumb at the bottom, and sets the point of it against the middle of the notch in the back of the matrice, pressing it forward towards the mould, and likewise downward by the shoulder of the notch close upon the stool, and drawing with his hind finger the lower half of the mould towards the ball of his thumb, he thrusts the upper part towards his fingers, and thus both registers of the mould are pressed against each side of the matrice, and the halves of the mould are closed together by means of the thumb and fingers. The ladle is now taken in the right hand, and two or three strokes given outwards with the ball of it upon the surface of the fused metal, which is thereby cleared of the scum. This done, a ladleful of the metal is taken up, and with due precaution poured into the body of the mould, and while yet hot it is received into the face of the matrice, where, as well as in the shank, it attains its correct form. What now remains to complete this process is only to take the upper half of the mould off the under, by placing the thumb of the right hand on the end of the wood towards the left thumb, and also the two middle fingers at the other end, when the letter and break usually contained in the under half of the mould are thrown upon a sheet of paper placed at hand for the purpose on a bench. After this a new letter may be cast, and also the whole number which the matrice contains. Of these letters no less than 3000 will be cast in the course of a day by one workman.

A considerable quantity being at length cast, boys are employed to separate the jets which are cast into the pots, and to polish the types by rubbing them nimbly on a stone, and also with leather under the fingers; after which they are ranged together on long sticks adapted to the purpose, that they may undergo the finishing process. The finisher, who must be an expert workman, slides off the column of types on the dressing stick. This impliment consists of a piece of mahogany provided with two end pieces of steel somewhat lower than the body of the types, and one of which, by means of a screw-pin inserted in the end of the stick, is moveable towards the other for the purpose of binding up the types placed in the stick, with their faces towards the back of the projection. In this way the types are adjusted, and the moulds brought minutely to the test, because, when bound up, the whole must lie fairly upon the stick like an even plate of metal. Indeed the letters must of necessity be uniformly straight and square on every side, generally of equal height, and lined in a manner perfectly even. They must be of a due size both in the foot and head, grooved with care, that the body of the letter may be contained in the two extremes of the foot, likewise sufficiently ground, barbed, and scraped, to qualify them for the printing-press; and besides all this, it is evident that their excellence must depend on their due form and proportion, as well as on the hardness of the metal of which they consist. The types being thus finished, are to be freed of imperfect characters, and then put up in proper order, when they are ready for use.

METALS. See CHEMISTRY and GEOLOGY. See also *Tinctures* under HERALDRY.

METAMORPHOSIS, the transformation of any thing into a different form, and which includes both the changes of insects and those of mythology, so beautifully described by ancient poets. Those of a mythological nature were of two kinds, apparent and real, as that of Lycaon into a wolf imagined to be real, and that of Jupiter into a bull, supposed to be only apparent. Lord Bacon and Dr Hooke have attempted to unriddle some of these metamorphoses, most of which have some allegorical meaning couched under them, relating either to morality or physics.

METAPHOR is a change of meaning from natural to figurative, for the sake of elegance in composition, or, according to Cicero, a similitude reduced to a single word; an image being thereby called from its proper subject to give the resemblance to another. A metaphor and a simile differ not in substance, but merely in form, the two subjects in the former being kept distinct in the thought only, whereas in a simile they are kept distinct both in the thought and expression. An allegory is a continued metaphor. See ALLEGORY and LANGUAGE.

METAPHYSICS. See MIND.

METASTASIO, ABBE PETER BONAVENTURE. this celebrated Italian dramatist, whose real name was TRAPASSI, was born at Rome 1698, and died 1782. So early did he discover a passion for poetry, and so remarkable was he for his lively genius in versification and music, that he was able to make verses extempore on any given subject before he was ten years of age. After school hours, he was accustomed frequently to amuse himself in reciting and singing his verses in an evening at his father's shop, where great crowds never failed to assemble in the street to hear him. The learned civilian, Gravina, happening to pass that way, and, listening to the music, was struck with the peculiar sweetness and melody of the child's voice, but still more so by his extempore verses. Finding that his parents were not in very affluent circumstances, he resolved to furnish the little bard with an opportunity of cultivating those splendid talents which had so much astonished and pleased him; and as the boy had still to remain at Rome to be educated, his father accepted of this generous offer, and conducted him to the house of Gravina. His former name, Trapassi, was converted into the Greek term *Metastasio*, Mutatio, expressive of the change that had taken place, and of his new situation. His patron had designed him the study of law as a profession, but, while thus occupied, the young Metastasio never failed secretly to make verses and read Tasso.

At the early age of fourteen, this astonishing genius produced the tragedy of *Il Giustino*, from which period Gravina encouraged him to cultivate his poetical and musical talents; and, at the age of 18, he was taken to Naples for the exhibition of his extempore singing, which seemed almost supernatural. In two years afterwards he lost his munificent patron, who left him his heir, as being a young man of the most promising abilities. Placed above want by this generous bequest of Gravina, he indulged in his favourite pursuit, and commenced his dramatic career with the *Didonne Abandonata*, which was acted at Naples in 1724. This musical drama, written by the advice of the celebrated Signora Bulgarella detta Romanina, the greatest female singer and actress of that age, and being set to music by *Sarro* and the first composers of Italy, was attended with the most astonishing success.

With his benefactress he quitted Naples and went to Rome, where, residing with her family, he began to lay the foundation of his future celebrity. By the production of several operas, his fame as a poet became unbounded; but having thoughtlessly lavished his fortune in munificence and good cheer among his admirers, he soon found himself in a state of considerable embarassment. While in this situation, he was, in 1729, invited to Vienna by the Emperor Charles VI. through the influence and recommendation of the imperial laureate, Apostolo Zeno, to whose situation he afterwards succeeded, with a pension of 4000 florins. At every court festival, some part of his compositions were brought forward, and the courts of Vienna and Madrid emulated each other in the presents with which they rewarded him. Charles the VI. offered to confer upon him the title of Count or of Baron; but as his ambition never extended farther than the attainment of literary fame, he declined this distinction.

In his poetry, Metastasio was pure, elegant, and sublime, and his descriptions were frequently fraught with the most exquisite taste and tenderness. The subjects of his muse were noble and interesting, and his descriptions were so admirably copied from nature, that even from the reader they seldom failed to excite a tear. Besides 28 regular operas and various other musical entertainments, his works comprise some versions from Juvenal and his favourite author Horace, together with reflections on the poetics of Aristotle, and numerous letters. They have been translated into French, and published by M. Richelet, in 12 volumes 12mo.

METASTASIS, in medicine, the transition of a disease from one part of the body to another.

METELIN, anciently Mytelene and Lesbos, an island of the Mediterranean, situated at the mouth of the gulph of Adramyti, is of a triangular form, about 42 miles in length and 26 in breadth, and presents a mountainous yet luxuriant aspect. It enjoys a fine climate, though subject to sudden storms; but the south coast is unwholesome. The mountain torrents are numerous, and two canals in the southern part of the island are terminated with spacious and convenient harbours. The mountains are well wooded, and fruitful vineyards and plantations of olives adorn the declivities of the hills. Olive oil and pitch are the principal productions. The wine of this island was, by the ancients, held in great estimation. The produce of grain and live stock is inadequate to the consumption of the country. Some manufactures of silk and flax are said to be carried on, and the trade in olive oil is considerable. About 50,000 or 60,000 quintals of this commodity are annually produced, the greater part of which is now sent to Constantinople. The inhabitants consist of an equal proportion of Greeks and Turks, and are estimated at 40,000.

Metelin, or Castro, the principal town, occupying part of the ground of the ancient city, is well fortified, and contains a population of about seven hundred. It is a bishop's see, and stands on the east coast. The houses of this place are of hewn stone, and constructed in form of a square tower; the lower part being designed as a granary or store, while the upper, which generally commands an extended prospect, is allotted as the place of residence. The other towns are Molivo, Petra, Akerona, and Eresso.

The island of Metelin is celebrated for beautiful females, and, in ancient times, the palm of beauty was contended for in the fane of Juno. In their manners, however, they are destitute of that delicacy and refinement which never fail to heighten and extol the female character, and which constitutes the chief excellence and glory of womankind. By the law of Metelin, it has till lately been customary for the eldest daughter to succeed to the entire property of the family, and what is more remarkable, the eldest daughter, at her marriage, inherited all the family possessions, and her parents were thus reduced to poverty. "We ourselves," says the Earl of Charlemont, "have been frequently shewn the eldest daughter parading through the town in the greatest splendour, while her mother and sister followed her as servants." By the interposition of the patriarch of Constantinople, this absurd custom has been in some degree changed. The eldest daughter now receives

Metempsychosis.

a third of the possessions, the second a third of what remains, and the younger branches in succession obtain a third of the residue.

METEMPSYCHOSIS, from the Greek, signifying *beyond* and *to animate,* is a term importing the doctrine of the transmigration of souls. This doctrine was inculcated by Pythagoras, who, from a conviction of the imperishable nature of the soul, came to the conclusion that, after quitting its present state, it must remove into another body; and he further supposed that the spirits of men, after death, were disposed of happily or unhappily, according as they had lived virtuously or viciously. The souls of bad men were doomed, by way of penance, to the bodies of wretched beasts, whereas those of the just and good were destined to those of happy creatures. Pythagoras is said to have been indebted to the Egyptians, or the ancient Brahmins, for the notion of a metempsychosis. The Chinese retain some impressions of it; but the Hindoos in particular have so decided a belief in the doctrine of transmigration, that they not only abstain from every kind of animal food, but in some instances tamely submit to the assaults of wild beasts. They will redeem from strangers any animals that are ready to be killed, and are even scrupulous of the life of an animalcule.

METEMPTOSIS, a chronological term derived from the Greek, and expressing the solar equation necessary to prevent the new moon from happening a day too late; in which sense it is contradistinguished from proemptosis, the lunar equation which is necessary to prevent the new moon from happening a day too soon. See *Chronology* under History.

# METEOROLOGY.

Definition.

This term is derived from *μελεωρος high,* and λογος a *discourse,* and may be understood as denoting that department of natural science which treats of the phenomena of the atmosphere in general.

In regard to the history of this pursuit, it has not unaptly been observed, that man is a meteorologist by nature. He is placed in such a state of dependence upon the elements, that to watch their changes, and to note the circumstances by which these changes are indicated, becomes to him a study at once of necessity and amusement. The daily tasks of the mariner, the shepherd, and the husbandman are regulated by meteorological observations; and the practice of constantly attending to the vicissitudes of the weather has endued the most illiterate of our species with a certain degree of prescience relative to its most capricious alterations. Nor in the more artificial forms of society does the subject lose either its use or its interest. Much of that tact which arises from personal observation is no doubt blunted and lost; but artificial means derived from science supply, to a certain extent, this deficiency; and, at all events, the importance of the study is universally acknowledged, and the application of means to promote its advancement is every where encouraged. The extent of this interest, indeed, is strongly expresssed in our most common habits of speech: the usual form of salutation among many nations conveys a meteorological wish, and the first introduction among strangers is a meteorological observation.

History.

Aristotle is supposed to be the first author who digested into any degree of systematic order the scattered observations and inferences of the early meteorologists. In his work "De Meteoris," he raises this subject to the rank of a science; and, in addition to the facts collected by his predecessors, he records a great variety furnished by his own research; arranging the whole with that rare skill which characterized all the writings of this distinguished philosopher. His pupil Theophrastus followed up his speculations with considerable success, and produced a treatise on meteorology, wherein he divided the topics usually comprehended in such works into four classes of prognostications, as applicable respectively to rain, wind, storms, and fair weather. Aratus is the next author whose performance attracts the notice of the reader in this branch of natural history. His "Prognostics" are an improvement on the less scientific discourse of Theophrastus; and yet it may perhaps be acknowledged, without derogating from the meteorological acquirements of this celebrated Greek, that his fame is more indebted to the circumstance that Cicero translated his book, than to the additions which he himself had made to the boundaries of a popular study. There is no doubt, however, that Aratus stood high in the estimation of the scholars and philosophers of antiquity; as a proof of which we have only to transcribe the eulogy of the poet,

"Cum sole et luna semper Aratus erit."

The Georgics of Virgil are well known to every classical reader, as containing an outline of all the meteorological learning of the times in which he lived.

Ipse pater statuit, quid menstrua luna moneret
Quo signa caderent Austri, quid saepe videntes
Agricolae propius stabulis armenta tenerent.
Continuo ventis surgentibus, aut freta ponti
Incipiunt agitata tumescere, et aridus altis
Montibus audiri fragor; aut resonantia longé
Littora misceri, et nemorum increbescere murmur.
Saepe etiam stellas, vento impendente, videbis
Praecipites coelo labi; noctisque per umbram
Flammarum longos a tergo albescere tractus,
Saepe levem paleam et frondes volitare caducas
Aut summa nantes in aqua colludere plumas.
At Boreae de parte trucis cum fulminat, et cum
Eurique Zepherique tonat domus; omnia plenis
Rura natant fossis; atque omnis navita ponto
Humida vela legit. Nunquam imprudentibus imber
Obfuit.——
Nec minus ex imbri soles, et aperta serena
Prospicere, et certis poteris cognoscere signis.

Nam neque tum stellis acies obtusa videtur,
Nec fratris radiis obnoxia surgere Luna:
Tenuia nec lanae per coelum vellosa ferri.—
Sol quoque et exoriens, et cum se condit in undas,
Signa dabit: Solem certissima signa sequuntur;
Et quae mane refert, et quae surgentibus astris.

During the ages which immediately succeeded the downfal of the Roman empire, there was no progress made in any department of natural philosophy. Men continued to gaze at the clouds, and to draw prognostications from their varying appearances, as they had done centuries before; but it was not till a date comparatively recent that the phenomena of the atmosphere began to be registered and examined on scientific principles.

It has been well remarked, however, that if the sages of antiquity be justly blamed for adopting implicitly the notions and prejudices of the vulgar, those of modern times may be charged with too eager a disposition to reject whatever savours of popular opinion. A collection of the numerous rules and remarks formed in the course of ages among different orders of men, deeply interested by their occupations in watching the changes of the sky, would undoubtedly contain some important truths, which the diligence and sagacity of the philosopher might discriminate, and employ for the basis of beneficial speculations. The most sanguine can hardly uphold the prospect, that mankind will ever arrive at such a pitch of knowledge as to be capable of prognosticating the future modifications of the atmosphere with the same precision with which they can foretel the successive revolutions of the heavenly bodies; yet the motions, however irregular in appearance, which prevail in the element that we breathe, are, equally with those performed in the regions of space, the result of certain fixed laws. The variable aspect of the sky proceeds partly from the direct action of the sun-beams, but principally from the winds which they excite and maintain. The unequal gravitation of the different portions of our atmosphere to the sun, and to the moon especially, must occasion some small effect in producing or altering the aerial current; and even the disturbing forces of the planets have a remote share, how minute soever, in the formation of meteors. Nor can we hesitate to conclude, with the ingenious and eloquent M. Bailly, that the notions so widely spread among men of the aspects and influences of the celestial bodies, are only the corrupted remains of astronomical science, already advanced to high perfection in some distant age of the world. If motions were to rise and cease instantaneously with the operation of their causes, the same succession of seasons exactly would attend on each revolution of the sun; but the currents of air acquire velocity by degrees, and thenceforth continue to flow till their force is spent. The varied face of our terraqueous globe will therefore modify the direction, the power, and the duration of the winds raised by the action of the solar rays. Hence an extreme complication of causes, which will produce an immense series of fluctuating events. That profound geometer M. De la Grange, has established by demonstration, that all the changes arising from the disturbing forces in the planetary system, are subjected to certain vast cycles, on the return of which the same motions are perpetually renewed. Similar periods, but of an extent which affright the imagination, probably regulate the modifications of the atmosphere; for whenever a coincidence of circumstances prevails, the series of occurrences must inevitably recur. The aggregate labours, indeed, of men continually transform the face of our globe, and, consequently, affect the operations of natural causes; but if the agency of animals be stimulated and determined solely by the influence of external objects, it follows that the reactions of living beings are comprehended in the same necessary system, and that all the events within the immeasurable circuit of the universe are the successive evolutions of an extended series, which, at the returns of some vast periods, repeats its round during the whole time which is allotted for the purposes of creation. Besides the grand cycle, there must evidently be many intermediate smaller periods, at the lapse of which our atmosphere will present nearly, though not exactly, the same fleeting aspects. Whether these bear any decided relation to the lunar revolutions cannot with certainty be affirmed. A copious collection of registers, formed in the course of ages, will probably at some future time lead to the discovery of certain remarkable periods, which will enable men to conjecture, with tolerable precision, the succeeding changes of the weather. In the meantime, this great object will be best promoted by careful observation, by the improvement of meteorological instruments, and by a minute registration of atmospherical phenomena.

*Constitution of the Atmosphere.*—The analysis of that fluid which surrounds our globe, and which appears essential to all animal and vegetable life, is one of the greatest atchievements of modern chemistry. It appears to consist of two distinct gases or airs combined in definite proportions; one part of oxygen being united to three parts by weight, or four parts by bulk, of azote. To these may be added a very small portion of carbonic acid gas, as well, perhaps, as some other elementary particles of organized bodies which escape during the process of decomposition. It is not even improbable that metallic substances themselves are affected by this universal solvent, and that the aerolites which fall occasionally from the atmosphere are the product of the action of its constituent gases on iron and nikel, the infinitesimal atoms of which may combine with the oxygen, and rise into the higher regions of the air, and afterwards, in obedience to the chemical law of aggregation, form into those masses which descend to the earth.

It is worthy of remark, that the constitution of the atmosphere is the same at all places on the surface of the earth, and at every elevation which has yet been examined. Experiments for this purpose have been made at very distant points, on the summits of the loftiest mountains, and even on those portions of the air which have been reached by means of balloons, at an altitude of five miles.

*Height of the Atmosphere.*—In regard to the extreme height of the atmosphere, the ancients entertained very erroneous opinions. They conceived that it was only bounded by the solid substance of the moon, and that the air was of a uniform density throughout the whole space which intervenes between the earth and her satellite. But the modern discoveries relative to the weight and pressure of that fluid have contracted its range within much narrower limits. Comparing the density of the air with the length of the mercurial column in a barometer, we should be led to infer, that if, the atmosphere were a uniform fluid, it could not exceed the elevation of five miles. But the air having a great expansive power, the higher portions of the mass which covers our globe, sustaining a diminished pressure, must dilate upwards, and occupy a proportionally wider space. Air, by artificial means, can be rarified about a thousand times,—a degree of tenuity which would not take place in the atmosphere under an elevation of forty miles. This, however, affords no data for ascertaining the limits of that rarity of which such a fluid is susceptible; and hence the conjectures of philosophers have no other bounds than the physical conditions of the problem which balances the centrifugal force of the air against the power of gravity. On this principle, according to Mr Leslie, the height of the atmosphere may be about 22,200 miles, or rather more than six and a half semi-diameters of the earth.

The same author imagines as not improbable, that an expanse far above the region of the clouds, is filled with some peculiar fluid very different from the grosser element spread below. The shooting stars which are seen every clear night, the fire-balls, and luminous arches which frequently appear, and which must traverse the sky at the height of several hundred miles, all seem to indicate the existence of a very ignitable medium. Such a collection of inflammable substances might be formed, he thinks, not only from the multiplied processes of art which emit these fluids, but also from the great laboratory of nature, which is constantly at work, generating and pouring forth hydrogen gas and its various compounds. The volcanic mountains which cover a large portion of the globe, continue to discharge almost incessantly immense streams of inflammable airs, a great part of which escape conflagration; and as hydrogen gas has little attraction for either of the constituent parts of the atmosphere, it rises upward through that fluid, without sustaining much loss in its passage.

On the supposition now stated, an attempt is made to account for several phenomena, the existence of which has not hitherto been explained. For example, the refraction which the rays of light suffer in slanting across the higher regions of the air, is greater than what calculation assigns to the corresponding density of the medium. But the supposed discrepancy would entirely disappear, were we to suppose those strata to consist of hydrogen gas, which is known to possess in a remarkable degree the power of refracting. Such, too, may be the principal cause of that lucid glow which even at midnight is diffused over the clear canopy of the heavens. Nor would it be unphilosophical to trace to the same source the pheuomenon of what is called the *zodiacal light*. This remarkable appearance, which, on the approach of evening, is very conspicuous in the fine climates of the earth and near the vernal equinox, has been sometimes ascribed to the extension of a supposed luminous atmosphere about the sun. But it has been shewn by La Place, that such an atmosphere, if it did exist, so far from stretching to our earth, would not reach the orbit of Mercury. It is therefore maintained by Mr Leslie, that the zodiacal light must have a terrestrial origin, and that it cannot be referred to any cause so likely to produce it as a gaseous fluid surrounding the terrestrial atmosphere, and acted upon by the direct rays of the sun.

These, however, are speculations rather meant to excite the inquiry of the scientific meteorologist than to rank as legitimate inferences from facts already known. Our business is to arrange the conclusions which have been distinctly brought to light, and to explain the methods which have been most successfully employed for extending the boundaries of this department of natural history. We therefore proceed to give, in the first place, a brief detail of the principal atmospherical phenomena; and, secondly, an account of the more common instruments which are used for ascertaining their nature and measuring their extent.

*Clouds.*—Among the numerous appearances which attract notice in the atmosphere, the first place is due to *clouds*; but as the outward form of these floating masses is very various and inconstant, it becomes extremely difficult to describe them in intelligible language. An attempt at classification has, however, been recently made by Mr Howard, who has devoted a large portion of his time to meteorological pursuits, and added some valuable facts to the knowledge of his contemporaries. According to him a cloud may be defined to be a visible aggregate of minute drops of water suspended in the atmosphere; and upon the ground of this description he proceeds to erect his system, in which he arranges all the forms and modifications clouds of under the seven following heads or classes.

1. *Cirrus.*—A cloud resembling a lock of hair or a feather; parallel, flexuous, or diverging fibres, unlimited in the direction of their increase.

2. *Cumulus.*—A cloud which increases from above, in dense, convex, or conical heaps.

3. *Stratus.*—An extended, continuous, level sheet of cloud, increasing from beneath.

These three Mr Howard denominates simple and distinct modifications, constituting, as will immediately appear, the elements of every other variety. The two next are what he calls of an intermediate nature.

4. *Cirro-cumulus.*—A connected system of small roundish clouds, placed in close order or contact.

5. *Cirro-stratus.*—A horizontal or slightly inclined sheet, attenuated at its circumference, concave downward, or undulated. Groups or patches having these characters.

Lastly, says Mr Howard, there are two modifications which exhibit a compound structure, viz.

6. *Cumulo-stratus.*—A cloud in which the structure of the cumulus is mixed with that of the cirro-stratus or cirro-cumulus; the cumulus flattened at top and overhanging its base.

7. *Nimbus.*—A dense cloud, spreading out into a crown of cirrus, and passing beneath into a shower. We have only room for a very brief illustration of these characteristics, which we give nearly in his own words.

The cirrus is alway the least dense, and generally the most elevated modification of clouds, sometimes covering the whole face of the sky with a thin transparent veil, and at other times forming itself into distinct groups of parallel threads or flexuous fibres. Its height is supposed to be from three to five mile above the surface of the earth.

The cumulus is generally of dense structure, appearing after a clear morning increasing from above, where its surface is convex, and forming, at its greatest magnitude, a pile of irregular hemispherical cloud. This takes place only in the afternoon, about the time of the greatest heat, and gradually diminishes towards evening, when it disappears. In this case it is an indication of fine weather.

The stratus is of a moderate density, and comprehends those creeping mists which rise from valleys and lakes in calm evenings. It frequently disappears in the morning, and is then an indication of the finest weather.

The cirro-cumulus appears to be formed by the descent of the cirrus, the oblique denser tufts of the latter changing into the spheroidal form, when the cloud assumes the appearance of a ball of flax, with one end left unwound or flying out. It is most frequent in summer, and when permanent, affords one of the surest indications of increasing temperature and fine weather.

The cirro-stratus assumes various appearances, from its being frequently connected with other modifications. By itself it is always an attenuated sheet of a uniform hazy continuity, when viewed overhead, and of great apparent density towards the horizon. In this state it gives rise to the phenomena of halos, mock-suns, &c. and indicates depression of temperature, wind, and rain. It is frequently seen resting on the summit of high hills, and in this state is usually regarded as foreboding rainy weather.

The cumulo-stratus is a fleecy cloud, and is sometimes observed to settle on the summit of a cumulus, while the latter is increasing from beneath. It commonly prevails in the sky when completely overcast, and apparently without any regard to temperature, as it is found to precede either a fall of snow or a thunder storm.

The nimbus generally appears in the form of a dense inverted cone of cloud, the upper part of which spreads in one continuous sheet of cirrus to a great distance from where the shower is falling. When the nimbus appears by itself, it generally moves with the wind, but when formed in the midst of cumuli, it sometimes moves in a contrary direction. For a representation of these different forms of clouds, we refer the reader to the figures in the first of the plates illustrative of meteorology.

*Rain.*—When different portions of the atmosphere are mixed, so as to produce a deposition of moisture, a cloud is immediately formed; but it does not follow that rain will necessarily fall in consequence of this extrication of moisture. The cloud will descend owing to its specific gravity; but if it reach a warmer stratum of air it will instantly reascend, and, passing into vapour, disappear in the pure atmosphere. If, indeed, the condensation of moisture be rapid and copious, there is no reason to doubt that rain will follow. Some authors, it is true, have been disposed to maintain, that rain never takes place unless there has previously been some electrical process going on among the minute particles of which the cloud is composed; and, in proof of this, they refer to the well-known fact, that the rain which accompanies a thunder-storm is always extremely heavy.

*Hutton's Theory.*--The theory of rain which has found most acceptance among philosophers, is that which was first proposed by the celebrated Dr Hutton. He conjectured, that the dissolving power of air, or its capacity for holding water in a state of vapour, increases with its temperature, but in a greater ratio; whence it follows that, when two portions of air of different temperatures, and both containing as much humidity as they are capable of dissolving at these temperatures, are mixed together, the joint quantity of moisture in the two portions will be greater than the air, after intermixture, is able to retain in the state of vapour, a quantity of the moisture must necessarily be condensed and precipitated.

*Experiments by Mr Leslie.*—From a number of experiments collected and performed by Mr Leslie, it would appear that air has its dryness doubled at each rise of temperature, answering to 15 centesimal degrees. Thus, at the freezing point, air is capable of holding a portion of moisture, represented by 100 degrees of the hygrometer; at the temperature of 15 centigrade, it would contain 200 such parts; at that of 30 it would dissolve 400; and at 45, on the same scale, it would contain 800 parts. Or, if we reckon by Fahrenheit's divisions, air absolutely humid, holds, at the limit of congelation, the hundred and sixtieth part of its weight of moisture; at the temperature of 59 degrees, the eightieth part; at that of 86 degrees, the fortieth part; at that of 113 degrees, the twentieth part; and at that of 140 degrees, the tenth part.—While the temperature therefore advances uniformly in arithmetical progression, the dissolving power which this communicates to the air, mounts with the accelerating rapidity of a geometrical series.

From the view now taken, it is obvious that the production of rain will be greatly facilitated by a frequent change of wind. The different currents of air are determined by the various degrees of heat and cold which distinguish the several climates of the earth and of the atmosphere; and these currents having unequal temperatures, and consequently unequal capacities for dissolving moisture, are almost never found to mingle without giving occasion to a precipitation of vapour in the form of rain. But as we shall have to speak of the winds more at length hereafter, we shall proceed at present to state some facts in regard to the quantity of rain which falls in different counties.

*Quantity of Rain.*--According to Mr Dalton, the average quantity of rain which falls annually in England, amounts to about 35.2 inches. In the mountainous district of Cumberland and Westmoreland, the relative quantity, as shewn by the rain-gage, is more than the

Rain.

double of that which falls in less moist counties; and thus, whilst the meteorological report from Essex gives only 19.5 inches, the return from Keswick is not less than 67.5. Our observations in regard to Scotland are not yet sufficiently numerous to warrant any very general conclusion. From a register kept in the neighbourhood of Perth, it appears that the annual depth of rain in that district is not quite 24 inches; and, from similar records preserved in more remote parts of the kingdom, there is reason to believe that the average of the whole does not exceed the moderate computation of thirty inches.

But it deserves to be noticed, that no instrument is less entitled to confidence than the pluviameter or rain-gage. Besides the loss occasioned by evaporation, we may reasonably suspect, as Mr Leslie observes, that the measure of the rain, hail, or snow, received by the means now mentioned, is not exactly proportioned to the extent of surface which the instrument presents; for while torrents pour down from the heavens, an eddy plays about the rim of the bason, deranging the regularity of the discharge. As a proof that a good deal depends upon accidental circumstances in the locality of the ground, in the form of the bason, and also in the degree of care with which the register is drawn up, we have only to mention, that whilst the quantity of rain at Keswick is given to the amount of 67·5 inches, a register kept at Carlisle, not more than 20 miles distant, does not give above 20 inches in the year.

The greatest source of discrepancy, however, arises from the nature of the ground where the observations are made; the difference betwen an elevated position and a level plain in the very same district, being uniformly accompanied with a striking variety of result. For example, it was found that, in the space of a year, while 12.1 inches only fell on the top of Westminster abbey, 18·1 inches were collected on the top of a house sixteen feet lower, and even 22.6 inches of rain on the ground. Similar observations have been made at the summit and near the base of hills of no great elevation. In such situations, says the writer just named, we can hardly suppose the clouds to stretch down to the surface, or to augment the lower portion of rain; we must hence refer the copious fall near the ground to some other cause. Most of the rain which falls proceeds from drifting showers of short duration; the current moves more slowly along the surface, and allows the drops to descend as fast as they are formed. But being forced to mount a swelling eminence, and thus compressed into a narrower stream, it hurries the mass of vapour along with it, and does not suffer the free and full discharge on the summit. At all events, there is no doubt that on both sides of a hill a pluviameter placed near the bottom indicates always a greater fall of rain than on the exposed top.

Notwithstanding these facts, which seem in no small degree attributable to the imperfection of the apparatus, it is proved by observation that a greater quantity of rain falls in a hilly country than in the contiguous plains. In the neighbourhood of Kinfauns Castle, for instance, a rain-gage is placed on the summit of a hill 600 feet above the level of the sea, and another in a garden at the base of the hill, elevated about 20 feet above the same level. The following are the annual results of the two gages for five years, as given by the observer to whom we have already alluded;

| Years. | Hill Gage. | Garden Gage. |
|---|---|---|
| | In Dec. | In. Dec. |
| 1814 | 33, .84 | 20, .05 |
| 1815 | 45, .70 | 24, .20 |
| 1816 | 52, .43 | 25 95 |
| 1817 | 44, .40 | 31 .01 |
| 1818 | 31, .10 | 28 .07 |
| Means | 41, .49 | 25, .66 |

No part of the above difference, it is remarked, can be ascribed to any thing in the situation of the garden gage, but its being lower down. It is fully exposed to the rain; and, as the best proof of this, it is only necessary to state that its average amount for six years is about two inches greater than that of another situated in an open country at the distance of about a mile.

It is observed by Mr Leslie, that in general twice as much rain falls on the western as on the eastern side of our island, and that the average annual quantity may be reckoned at 30 inches, that is, if it were all collected, it would form a sheet of water of that depth. According to this estimate, the whole discharge from the clouds in the course of a year, on every square mile of the surface of Great Britain, would at a medium be 1,944,643, or nearly two millions of tons. This gives about 3000 tons of water for each English acre.

Hail and Snow.

*Hail and Snow.*—It has long been known to the most illiterate, that snow and hail are nothing more than the moisture suspended in the atmosphere, congealed by cold, and precipitated to the earth. When clouds are formed at an elevation where the temperature is below 32°, the moist particles are necessarily frozen; and if the temperature of the lower regions be much above the freezing point, the snow will be wholly or partially dissolved, and reach the ground in the form of sleet or very cold rain. Hail, from its greater solidity, does not so readily dissolve while passing through a warmer stratum; on the contrary, it frequently descends even in the summer months, and gives to the fields a momentary appearance of the very depth of winter. There can be little doubt that the moisture of which hail consists had been collected into large drops of rain previous to being congealed; and Mr Leslie has proposed an explanation of the manner in which the congelation is imagined to take place. "If we examine, (says he) the structure of a hailstone, we shall perceive a snowy kernel incased by a harder crust. It has very nearly the appearance of a drop of water suddenly frozen, the particles of air being driven from the surface towards the centre, where they form a spongy texture. This circumstance suggests the probable origin of hail, which is perhaps occasioned by rain falling through a dry and very cold stratum of air."

*Evaporation.*—Closely connected with the subject of rain is that of evaporation. There can be no doubt that the quantity of rain which falls in any given place must bear a certain relation both to the amount of evaporation, and also to the moisture which can be held in solution by the atmosphere, at the average temperature of that place. A table founded on the relation of these quantities, deduced from the law of aqueous solution in the atmosphere, gives an approximation to the depth of rain as found by actual observation; and though it is extremely difficult to measure with accuracy the quantity of evaporation from the surface of the ground, yet a set of well conducted experiments on the subject would probably give results coinciding very nearly with the quantities computed from the laws of temperature and moisture.

The observations made at Liverpool by Dr Dobson, about forty years ago, afford reason to conclude that the annual evaporation from the surface of the water in that latitude amounts to nearly 37 inches. It has been justly questioned, at the same time, whether the principle on which his chief experiments were performed, must not necessarily have exhibited a product considerably greater than the truth. The evaporating vessel, or atmometer, as it is called, should be placed at least out of the reach of the direct influence of the sun, and sheltered, to a certain extent, even from the action of the wind. From experiments conducted in the circumstances now described, the annual evaporation in the latitude of Perth has been found to be about 20.523; whilst, from similar trials made by Mr Dalton, the quantity of moisture exhaled from the ground, on an average of three years, was ascertained to be nearly 25·158.

If, however, the quantity of moisture evaporated were, in all cases, to equal that which falls in the form of rain and snow, it might be suspected that the principles of the above calculation were false, in as much as it admits of no supply for springs and rivers. But we must call to mind that the quantity of rain which falls on mountains, and other elevated tracks of land, greatly exceeds that which falls in the plains, and also that it is chiefly from the former that springs and rivers derive their waters. It has been calculated that the quantity discharged into the sea by all the rivers in the southern division of the island amounts only to about 13 inches of rain for the whole surface, leaving not less than 17 inches to be evaporated in the form either of simple water or in that of the chemical elements into which that fluid may be decomposed. In this department of natural history, however, we possess nothing more than a certain approximation to the truth. All the experiments and observations which have hitherto been supplied even by the learned, are extremely vague and objectionable; and it is principally for this reason that so much reliance is placed on those results which combine in their evidence the calculations of theory with the truths of experiment.

*Formation of Dew.*—The deposition of moisture in the form of rain, naturally suggests an inquiry into the precipitation of the same substance in the form of dew. Until very lately, it was universally believed that, as dew is always most copious in clear and calm nights, it was occasioned by a reduction of temperature in the atmospherical fluid. It was reserved for Dr Wells to prove, by a series of very ingenious and satisfactory experiments, that dew is never deposited upon any substance till the temperature of that substance has been reduced below that of the surrounding atmosphere. He found that the surface of the ground, as well as other bodies, has its temperature reduced below that of the atmosphere, by being freely exposed to the clear sky; and that whenever a proper substance intervenes to skreen it from this exposure, the reduction of temperature does not take place. The same fact was repeated in regard to such a variety of substances, that the quantity of dew, all other things being equal, was pronounced to be, in all cases, in direct proportion to the degree in which the particular substance was exposed to the action of the atmosphere. For example, he tells us that he "placed, on several clear and still nights, ten grains of wool upon the middle of a painted board 4½ feet long, 2 feet wide, and one inch thick, elevated four feet above the grass plat, by means of four slender wooden props of equal height, and at the same time attached loosely ten grains of wool to the middle of its under side. The two parcels were consequently only an inch asunder, and were equally exposed to the action of the air. Upon one night, however, I found that the upper parcel had gained 14 grains in weight, but the lower only four." On a second night the quantities of moisture acquired by like parcels of wool, in the same situation as in the first experiment, were 19 and 6 grains; on a third 11 and 2; on a fourth, 20 and 4, the smaller quantity being always that which was gained by the wool attached to the lower side of the board.

To illustrate still farther the effect of exposure to the sky, we give in his own words the following experiment, in which is strongly contrasted the result of free atmospherical action with the partial deposition of dew on the same substance when protected from that action. "I bent a sheet of pasteboard into the shape of a house-roof, making the angle of flexure 90 degrees, and leaving both ends open. This was placed one evening, with its ridge uppermost, upon the same grass plat, in the direction of the wind, as well as this could be ascertained. I then laid ten grains of wool on the middle of that part of the grass which was sheltered by the roof, and the same quantity on another part of the grass plat fully exposed to the sky. In the morning the sheltered wool was found to have increased in weight only two grains, but that which had been exposed to the sky sixteen grains. In these experiments the view of the sky was almost entirely cut off from the situations in which little dew was found. In others where it was less so, the quantity gained was greater. Thus, ten grains of wool placed upon the spot of the grass plat which was directly under the middle of the raised board, and which enjoyed, therefore, a considerable oblique view of the sky, acquired during one night seven, during a second nine, and during a third twelve grains of moisture; while the quantities gained during the same times by equal parcels of wool laid upon another part of the grass plat which was entirely exposed to the heavens, were ten, sixteen, and twenty grains.

Upon these and a great variety of similar experiments, Dr Wells founded the following theory of the production of dew. Proceeding on the fact that bodies have a tendency to throw off by radiation caloric to other bodies whose temperature is lower, he assumes that the earth is continually throwing its heat into the high and colder regions of the atmosphere: that in the day-time the effects of this radiation are not measureable by any instrument, being fully counterbalanced by the greater accession of heat from the direct influence of the sun; but that, during the night, when this counteracting cause is removed, the radiation is attended by the reduction of temperature already stated, unless when its effects are prevented by the interposition of clouds, which act the part of a skreen in covering the surface of the ground. In a word, the production of dew is owing to the cold produced in certain bodies on the surface of the earth by means of the radiation of their heat into a clear sky; and, accordingly, it is always found, that, of two similar substances, the one that is most cooled is also the most dewed.

Dr Wells established, in the course of his experiments, a distinction between bodies which conduct heat freely and those which radiate that substance with readiness. The more free and copious the radiation, the greater is the deposition of dew. He found also that grass on a clear and still night was uniformly colder than a gravel walk, evidently owing to the different quantities of heat which they received by conduction from the ground below; and that, on the same principle, filamentous and downy substances become colder than all others.

The principles established by Dr Wells overthrow the opinions formerly entertained in regard to the origin of dew, as an exhalation from the soil analagous to evaporation. If the cold were produced by evaporation alone, the difference between the temperature of the ground and that of the atmosphere near it would diminish as the air became moist, and would disappear altogether when the latter were completely saturated. But the cold observed by Dr Wells continued long after a deposition of moisture had taken place, and when not only evaporation must have ceased, but caloric must have been disengaged or become sensible by the vapour passing into a liquid state. Besides, evaporation could have nothing to do with the reduction of temperature observed on substances exposed in a state of dryness, and not in contact with the earth.

There is a curious fact mentioned in the book of Judges, (chapter vi. v. 36.) which shews that the principle on which dew is formed was not altogether unknown to the ancient Jews. "And Gideon said unto God, If thou wilt save Israel by mine hand as thou hast said, behold I will put a fleece of wool in the floor: and if the dew be on the fleece only, and it be dry on all the earth beside, then shall I know that thou wilt save Israel by mine hand, as thou hast said. And it was so, for he rose up early on the morrow, and thrust the fleece together, and wringed the dew out of the fleece, a bowl-full of water. And Gideon said unto God, Let not thine anger be hot against me, and I will speak but this once; let me prove, I pray thee, but this once with the fleece; let it now be dry only upon the fleece, and upon all the ground let there be dew. And God did so that night: for it was dry upon the fleece only, and there was dew on all the ground."

*Hoar frost.*—When, after the deposition of moisture, the temperature of the ground is reduced to 32° or under, the dew which is formed congeals into *hoar frost*. Agreeably to the principles illustrated in Dr Wells' experiments, this result may take place even when the temperature of the atmosphere, a few feet above the earth, is considerably upwards of 40°. It is no uncommon thing to witness a copious deposition of frozen moisture, particularly after a clear and calm night, although the temperature, as indicated by a self-registering thermometer, has not been depressed under 42 degrees. This curious fact is satisfactorily explained by the theory of Dr Wells, which, at the same time, affords a reason for the practice adopted by gardeners, of stretching over their more tender plants any covering, however thin, that serves to screen them during the night from a direct exposure to a clear sky.

*Wind.*—The motion of the atmosphere gives rise to another phenomenon, extremely interesting to all classes of men, that, namely, of *wind*. The main cause of that flow of air known by the term now employed is undoubtedly the unequal distribution of heat throughout the regions of the atmosphere, which is incessantly affecting the density and disturbing the equilibrium of the mass in particular places. The alternation of day and night, therefore, and the annual revolution of the seasons, are the periodical and unceasing occasions of wind. Heat rarifies the air, and the current which rushes from all sides towards any heated portion of the atmosphere is easily explained and computed from the diminution and pressure which rarification produces. If a fire be kindled in an open field, it is evident that the rush of air must proceed from all sides; and if the warm air were to cover a very wide extent of surface, its influence would be felt at a considerable distance, and the several winds would converge towards the centre of rarifaction.

The celerity of the flow, says Mr Leslie, is precisely the same as that of the efflux from a small aperture under the pressure of a column equivalent to that diminution, or to the difference between the weight of the warm air and of an equal volume of the external fluid. Thus, suppose a chimney 21 feet high were heated up to 90 degrees of Fahrenheit's scale, the air in the flue being therefore expanded one fifth part, or four feet, would be driven upwards by the pressure of a column compensating this difference; the velocity would hence be $8 \times \sqrt{4} = 16$ feet every second, or at the rate of about eleven miles in an hour.

It is on these principles that philosophers have attempted to explain the phenomena of sea and land breezes. In the sultry regions of the tropics, a refreshing wind blows from the sea as the day advances towards noon, and which is succeeded in the evening by an opposite current from the interior of the land. In open seas, and especially near the equator, the thermometer scarcely varies a degree in the whole course of a day; but on the land, the change of temperature between day and night, in similar situations, will rise often higher than 126. This great variation in the temperature creates a current in the atmospherical fluid, amounting to

Winds.

more than twenty-five miles an hour; the rush from the sea towards the land being in general more powerful than the corresponding flow from the latter towards the former.

The trade winds which, within the tropics, blow at all times from east to west, are the most remarkable of all the aerial currents, and have long employed the ingenuity of philosophers to account for their source and character. Descartes imagined that these winds were occasioned by the inertia of the atmosphere, which prevented that portion of it which is near the equator from acquiring the full rapidity of the earth's rotation. The air being thus left behind as the globe rolled from the west, would have an apparent motion in the opposite direction, and seem to blow from the east. Dr Halley proposed a different hypothesis to account for the phenomenon in question. He suggested, that as the spot where the sun's vertical rays exert their greatest heating energy is, in the lapse of a day, successively transferred from east to west round the circumference of the globe, it must, as a centre of confluence, draw after it a current of air. The current thus formed would result from the excess of the streaming from the east above that from the west; and it would therefore advance with a tardy pace, following at a distance the powerful energy of the sun.

The principal objection to these hypothetical explications arises from the fact, that the torrid zone stretches mostly over the ocean, and embraces only a very small portion of land, and, consequently, that the heat excited on the surface of the globe by the diurnal passage of the sun is so trifling as not to occasion the slightest current of air. The true theory of the trade winds is due to Mr George Hadley, who gave his views to the world in the form of a communication to the Royal society in the year 1735. By combining in some measure the idea of Descartes with the opinion of Halley, he produced, observes Mr Leslie, a clear and simple account of the cause of the trade winds, which appears entirely consistent and free from every objection. "Though the daily variation of temperature be very inconsiderable within the tropics, yet the annual accumulation of heat renders the equatorial regions much warmer than the higher latitudes, and, consequently, maintains a perpetual current of air from either side. If these aerial motions were not modified by the figure and rotation of the globe, there would always be two opposite winds blowing directly from the north and from the south to the equator. But the stream which perhaps originates at the northern tropic, in advancing to the equator, must seem gradually to deflect towards the west, in consequence of the increasing velocity with which the successive parallels of latitude are carried eastwards. During the time the current takes to perform its journey, it is apparently transported to the west, through a space equal to the arc described by the equator above the corresponding arc described by the tropic. The current from the southern tropic is equally bent towards the west. When both of them meet at the equator, their opposite impulsions are from the north and south, and they flow directly west in a single united stream, and with accumulated force. The apparent motions of the different streamlets which, from both hemispheres, conspire to constitute the trade-wind, is represented in Plate 128. Fig. 1.

Monsoons.

Such is the character of that general wind which encircles the globe, flowing with slight deviation constantly from the east, and spreading over a zone of more than fifty degrees in breadth. It sweeps the Atlantic ocean from the coast of Africa to Brazil, and the Pacific from Panama to the Phillipine isles and New Holland, and, again, the Indian seas partially from Sumatra to Zanguebar.

*Monsoons.*—These winds are however considerably affected by the vicinity of large tracks of land within the torrid zone; for as the sun acts with much more power on land than on water, and as the degree of rarifaction in the atmosphere incumbent upon the former is proportionate to the accumulated heat, the direction of the aerial current is thereby a good deal modified. In summer, the point of greatest heat is in the northern tropics, in winter it changes to the southern; instead therefore of the great eastern stream continuing its course in a direct line westward, there are generated two opposite periodic winds, alternating towards the north and south, and known by the name of monsoons. When these point towards the equator, they appear to come from the north-east or south-east, and when they recede from the equator, they conjoin such an apparent velocity from the west, that they blow either from south-west or north-west. A diagonal motion is the result of these combined tendencies; a fact which is illustrated by the actual condition of the winds in the tropical regions of the Indian ocean.

Besides the monsoons, there is a variety of other local winds, of which the direction and the quality are determined by a number of geographical as well as of astronomical circumstances. The *bize* is a very cold penetrating wind, which blows from the frozen summits of the Alps and Pyrennees. Naples, again, and the south of Italy, are occasionally infested with a hot, moist, and relaxing wind, from the opposite shores of the Mediterranean, called the *sirocco*. The *harmittan* is frequent in Africa and some other countries of the East, and is described as a cold disagreeable current of air, which parches and withers every thing. The *samiel* or *simoon* appears to be peculiar to the extensive deserts of Arabia. It is a withering pestilential blast, rushing over the waste with irresistible fury, drying up every substance over which it passes, and carrying with it immense columns of sand.

*Rainbow.*—For an account of lightning and other meteoric phenomena connected with thunder, we refer the reader to our article ELECTRICITY, in Volume III. and proceed at present to state a few particulars relative to such appearances in the atmosphere as are more strictly optical, and respect of course the laws of vision. Among these, the most remarkable on many accounts is the rainbow, a phenomenon which was first reduced to mathematical calculation by the celebrated Descartes, and was afterwards fully explained by the still more illustrious Newton. When the aqueous globules collect into large drops, the rays of light, which strike at a certain angle, converge by refraction to a point of the posterior sur-

Halo.

face; and after undergoing one or more reflections, they come forth dissected into their primitive colours. These phenomena occur whenever the sun shines upon the falling drops of rain behind the spectator, the coloured arch being the portion of a circle whose centre is a point in the sky directly opposite to the sun. The primary or interior bow is formed by a single reflection, and lies 45° beyond that centre; but the secondary or superior bow, produced by a double reflection, appears with inverted tints at the distance of 56°. It hence follows, that rainbows are only visible when the altitude of the sun is below 45° and 56°; and consequently, in summer, they are not seen in this climate within two or three hours of mid-day. A similar appearance produced by the refracted light of the moon, is frequently visible in particular states of the weather; but the colours are much fainter, and the spectacle, on the whole, by no means so imposing.

*Halo.*—An appearance somewhat analagous to the rain-bow, and occasioned by the diffusion of a thin vapour through the atmosphere, is known to the student of meteorology under the name of *halo.* This phenomenon presents itself under the form of a coloured ring encompassing the sun or moon, at a degree of distance which is supposed to have some relation to the density of the medium to which it owes its existence. A rariety of experiments have been devised, with the view of illustrating the principle on which this natural appearance is founded; and Mr Leslie informs us, that a very good idea of the process may be formed if the rays from a hazy or mottled sky be received upon a sheet of white paper, held before a small hole in the window shutter of a dark room. Even when the sun shines from an azure firmament, circles of the richest tints may be produced by experiment. If a hot poker be held below and a little before the small hole of the shutter, and a few drops of water thrown upon it, the sun will be painted on the paper like the glowing radiations of the *passion-flower.*

Parhelia, or mock-suns, coronae, and anthelia, resemble not a little, both in their appearance and physical cause, the meteorological fact which has just been described. They all arise from an irregular and undue degree of refraction, aided by an imperfect reflection of the prismatic colours. Mr Scoresby, in the *Journal of a Voyage to Greenland,* supplies some interesting details respecting this branch of natural history, which are well worth the attention of the curious reader. Coronae may be observed, says he, whenever the sun shines during foggy weather. Under such circumstances, an observer elevated on a ship mast, ninety or a hundred feet above the level of the sea, will perceive one or more prismatic circles depicted on the fog. These circles are all concentric, the centre being in a line drawn from the sun through the point of vision, until it meets the visible vapour in a situation 180° distant from or opposite to the sun. The number of coronæ varies from one to four or five. They are yet generally the most numerous, and the colours the most brilliant, when the sun is brightest and the fog most dense, and low or partial. In all cases, the shadow of the head of the observer is seen in the centre of the circles, together with the shadow of the "crows-nest" at the mast-head, and also of the masts and sails immediately adjoining. The interior circle, occurring at the centre, is so small, that, being highly luminous, it forms a brilliant anthelion, or glory, round the spectrum of the observer.

We cannot enter farther into the physical circumstances whence such appearances originate, than to remark, that they seem to require a certain degree of frost to bring the moisture of the atmosphere into the form of minute spiculae. M. Bouguer, who witnessed the appearance of anthelia and coronae on one of the Andes, at the time of sun rising, remarks that "Le phenomene outre cela ne se trace que sur les nuages, et même sur ceux dont les particules sont glaciés, et non pas sur les gouttes de pluie, comme l'arc-en-ciel." Dr Young, in like manner, ascribes these gorgeous visions to the combined reflections of the solar rays from the natural facets of the snowy spiculae floating abundantly in the air.

In Mr Scorseby's book there are also several interesting particulars relative to irregular or extraordinary horizontal refraction. In very hot or very cold climates, where the deposition of moisture is affected by sudden and partial refigerations of the atmosphere, the optical properties of surrounding objects are materially altered, appearing often to be greatly elevated above their natural level, and even presenting double or inverted images. To a certain extent, this effect is familiarly experienced whenever the wind blows from the east or north-east. Distant hills meet the eye with a marked difference in their height; and ships at sea appear considerably elevated in the water. This latter effect is by our sailors called looming; and it is only when the images of things are inverted, that the deception of vision is known by the names of *mirage* and *fata morgana.* The shipping and range of buildings on the shore of Naples have, from the coast of Sicily, appeared sometimes to be floating in the air. In the autumn of 1798, the coast of France was distinctly seen, from the beach at Hastings, as being raised above the sea; the appearance lasted about an hour, and then sunk beneath the horizon. A phenomenon somewhat similar was witnessed at Ramsgate, by Professor Vince, in the course of the following year.

"On the morning of 9th July," says Mr Scoresby in his Journal, "the land, and a number of ships that came within sight, as well as the ice, and indeed all distant objects, were strongly distorted. Inverted images of two ships occasionally double were seen in the air, which I imagine were at least ten miles beyond the limits of direct vision; for we approached them about this distance without being able to see them." See Plate 127. Fig. 9. "I noted several vessels that had their hulls elevated to the apparent magnitude of a castle, the height of the hull in some instances being equal to that of the masts; in two or three positions, the courses seemed to be separated twenty or thirty yards from the hull, instead of being nearly in contact." See Plate 127. Fig. 10.

Some time after, the same phenomenon was repeated with a certain degree of variety. "This evening, the refracted ships with their images were most beautifully and distinctly defined, and especially the latter, which appeared in an inverted position in the air." See Plate 127. Fig. 11. "Of some vessels whose hulls were beyond the horizon, there were two, and of one ship three, distinct inverted images, each exhibited in a different stratum of refracted ice, one above another; the lowest image being at the altitude of more than the apparent height of the ship's mast above the mast-head of the original."

The scientific reader knows that Dr Woolaston has suggested an explanation of the more ordinary appearances of refraction, which may perhaps be extended to such phenomena as those now under consideration. His experiments for this purpose refer to the peculiar refractive effects of media possessing various densities, when brought into contact, or united by mutual penetration. He put, for example, a small quantity of clear syrup into a square phial, and carefully poured on the top of it an equal quantity of water; upon which, small objects seen on the part of the mixture where the syrup and the water were beginning to combine, appeared inverted, with a direct image above. A similar experiment with water and spirit of wine above it, gave analogous results; but when the object examined was placed nearer to the rarer medium, (the spirit of wine,) the inverted and erect images were seen below.

Dr. Brewster has devised another method for illustrating the same principle; which consists "in holding a heated iron above a mass of water, bounded by parallel plates of glass. As the heat descends through the fluid, we have a regular variation of density, which gradually increases from the surface to the bottom. If we now withdraw the heated iron and substitute a cold body in its place, or even allow the air to act alone, the superficial strata of water will give out their heat, so as to have an increase of density from the surface to a certain depth below it. Through the medium thus constituted, many of the phenomena of unusual refraction may be seen in the most beautiful and satisfactory manner, though the difference of density in the medium employed is only that produced by the agency of heat alone.

### *Description of Meteorological Instruments.*

*Barometer.*—It is to the celebrated Torricelli that the scientific world is indebted for the invention of this instrument, as well as for the discovery of the principle which it is employed to illustrate. A familiar example will illustrate both. If a tube open at both ends, with a piston exactly fitted to it, have its lower extremity, to which the piston has been previously pushed down, immersed in water, it will be found that, on drawing up the piston, the water will follow it, and continue to do so till it has risen to the height of about 33 feet. The same thing will take place if the tube be immersed in mercury, with this difference that, as the mercury is more than twelve times heavier than water, it will rise to the height of only 30 inches or thereby. In both cases, the effect is owing to the weight of the atmosphere, which is equal to a similar column of water of about 33 feet, or to a column of mercury of about 30 inches. By drawing up the piston, the pressure of the atmosphere is removed from the portion of the fluid immediately under it, while the weight continues to act on the surface of all the rest. The consequence is, that the liquid is forced up into the tube, till the column be of such a length as to balance the weight of the atmosphere.

To construct a barometer, therefore, let a glass tube of about three feet in length, and open at one end, be filled with mercury, and then inverted perpendicularly into a basin containing the same liquid, so that the open end may be under the surface of the latter, the mercury in the tube will be found to sink down from the upper extremity, and stand at the point to which it would have risen, had it been raised by means of a piston as explained above. In this form it constitutes a barometer or weather-glass, denoting, by its risings and fallings, the varying pressure of the atmosphere. To measure the amount of the variations which are thus produced, a scale is placed on the frame parallel to the tube, and divided into inches and the decimal parts of inches; the notation beginning at the surface of the mercury in the basin. See Plate 128. Fig. 2.

To obtain a correct return of the variations of the atmosphere during the night as well as the day, and even during a temporary absence of the observer, the resources of art have been employed to invent a *self-registering* barometer. This is effected by allowing some light substance to float on the surface of the mercury, so attached to the tube as not to sink again with the descending column. The expedient is extremely simple, but the friction which accompanies the action of the marker, as well as some other inconveniencies which appear inseparable from this form of the instrument, have diminished the confidence with which the invention was at first received.

The barometer has been used not only as an index of atmospherical changes, but also as a convenient instrument for measuring the heights of mountains. The mercurial column sinks an inch in the tube for every 900 feet of perpendicular ascent, and hence affords an easy principle for determining the elevation of the highest ground to which a traveller can ascend. But it must be observed, that the temperature of the air in which the observation is performed has some small effect on the mercury, for which a suitable allowance must be made, whether in reference to weather or climate. Thus, if the barometer, at the temperature of 32°, stand at 30 inches, it would, under the same pressure, at the temperature of 62°, stand at one-tenth above 30 inches. In order, therefore, to attain the greatest accuracy in barometrical measurement, every observation should be reduced to what it would be, were the temperature of the mercury at 32° of Fahrenheit. This may be done by allowing 3000 parts of an inch for every degree that the temperature differs from 32°, either substracting that quantity from the observed height of the column, or adding it to it, according as the temperature is above or below the freezing point.

It is customary to reduce the expression of barometrical instruments placed at different elevations by applying a rule somewhat similar. As the mercurial column sinks one-tenth of an inch for every 90 feet of elevation, the observations made by means of an instrument placed at any height above the sea may

# METEOROLOGY.

PLATE 127

*Fig. 1.*
*Cirrus*

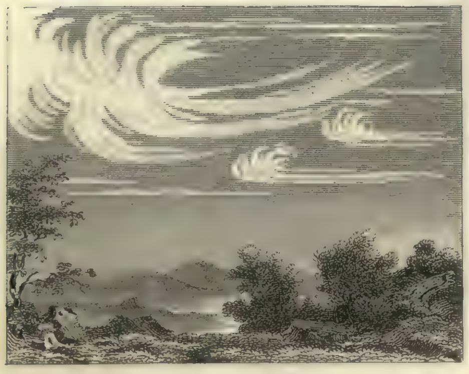


*Fig. 2.*
*Cumulus*

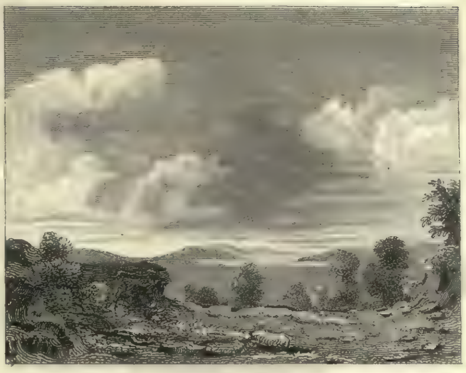


*Fig. 3.*
*Stratus*

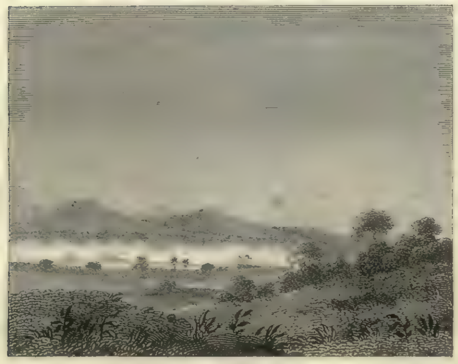


*Fig. 4.*
*Cirrocumulus*

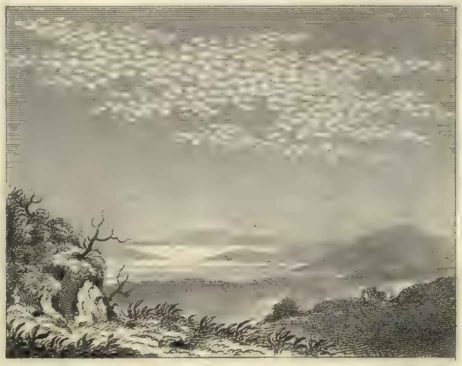


*Fig. 5.*
*Cirrostratus*

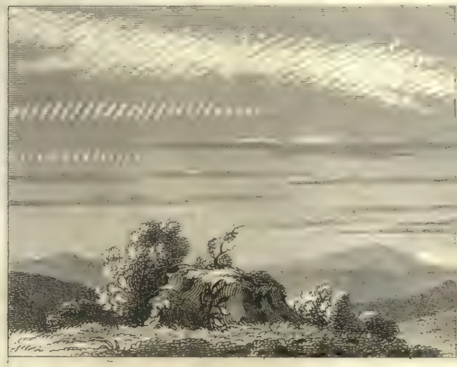


*Fig. 6.*
*Cumulostratus*

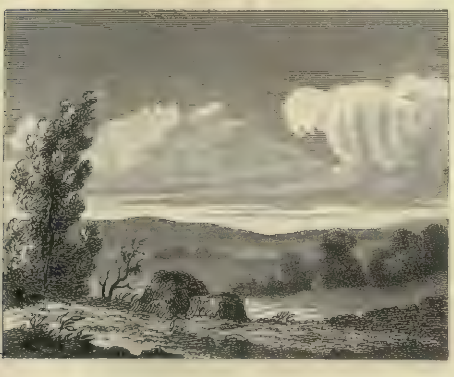


*Fig. 7.*
*Nimbus*

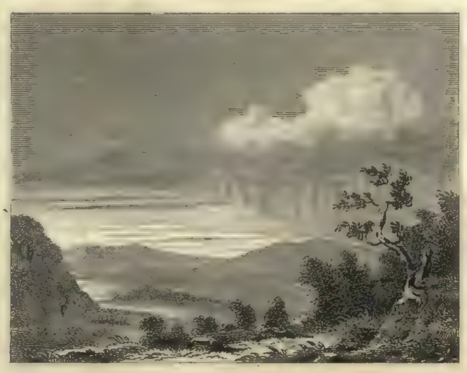


*Fig. 11.*

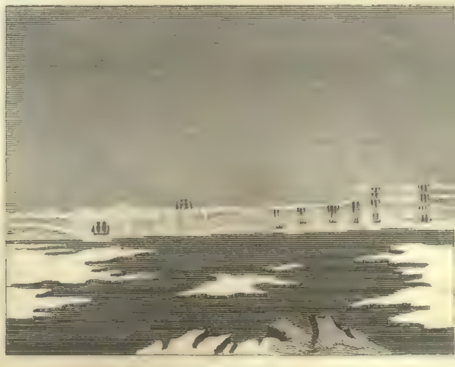


*Fig. 10.*

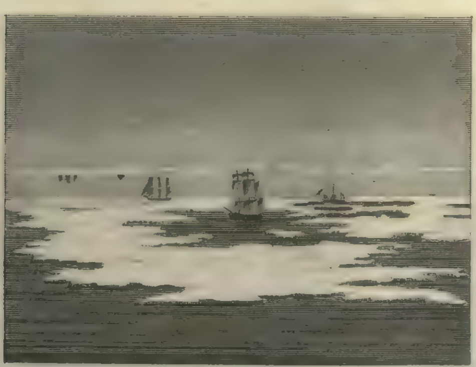
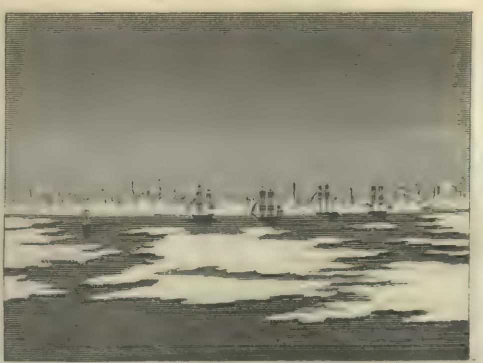


*Fig. 9.*



*Drawn & Engraved for the Encyclopædia Edinensis by W. H. Lizars Edinburgh.*

be reduced to what they would have been if made on the sea-shore, by allowing the 1000th part of an inch for every foot of elevation, and adding it to the observed height. An example will illustrate the principle of these corrections.

Suppose the place of observation is 200 feet above the level of the sea; that the height of the barometer there is 29·525; and that the temperature of the air is 60° or 28° above 32°, the standard point:

| | |
|---|---|
| Observed height, - - - | 29·525 |
| Deduct for excess of temperature 003 × 28, | ·084 |
| Altitude if temperature of mercury were at 32°, | 29·441 |
| Add for elevation of place 001 × 200, - | ·200 |
| Altitude at level of sea, - - | 29·641 |

Such of our readers as wish to study this subject more formally and scientifically than our plan will permit, will find much valuable matter in a paper written by Professor Playfair, and published in the last edition of his works, entitled, "On the causes which affect the accuracy of barometrical measurements."

It is well known to those who have paid any attention to the indications of the barometer, that, though the fall and ascent of the mercurial column be connected with the varying gravity of the atmosphere, these changes are not always followed by a deposition of moisture. Those modifications of the atmospherical fluid which affect the instrument of which we are now speaking, arise most commonly from a change of temperature, and from the consequent variety which is produced in the direction and rapidity of the aerial currents. In tropical climates, accordingly, there is a daily fluctuation in the barometer, occasioned by the diurnal vicissitude of heat and cold. Even the great principle of gravitation appears to influence the movements of the mercurial column; for, according to some well authenticated observations, the barometer rises at the conjunction and opposition of the moon. But there is still a want of facts to establish any general doctrine on this subject; the inferences which appear to be warranted by one set of observations being not unfrequently opposed by others made in similar circumstances, and by means of instruments equally perfect.

Connected with the barometer both in principle and object, the sympiesometer, a piece of meteorological apparatus invented by Mr Adie of Edinburgh, claims our attention. In the first volume of the Philosophical Journal, there is inserted a description of this instrument from the hand of the inventor himself, to which we beg leave to refer the scientific reader. The name is taken from the two Greek words, συμπιεζειν, *to compress*, and μετρον, *a measure*; denoting the property it possesses of measuring the weight of the atmosphere, by the compression of a gaseous column.

The principle of the sympiesometer, which is represented in one of its forms in Plate 128. Fig. 3. consists in employing an elastic fluid, or gas, different from air, and any liquid, except quicksilver, which neither acts upon the gas which it confines nor is perceptibly acted upon by the air, to the contact of which it is in some manner exposed. Hydrogen gas, azotic gas, or any of the gases not likely to be absorbed by the enclosing fluid, may be used; but Mr Adie preferred hydrogen gas, as being superior to any that he had tried.

The instrument consists of a tube of glass, A, B, C, of about 18 inches long, and 0.7 of an inch diameter inside, terminated above by a bulb A, about two inches long inside and half an inch diameter, (but this will vary as the instrument is required to have a greater or lesser range,) and having the lower extremity, B, bent upward, and expanding into an oval cistern, C, open at top.

Referring to the figure for an idea of its structure, we have simply to observe, that the gas introduced into the tube of the sympiesometer changes its bulk, or occupies more or less space, according to the pressure of the atmosphere upon the surface of the oil in the cistern *l*. The scale *m n* for measuring the change in the bulk of the gas occasioned by a change of pressure, is formed experimentally by placing the instrument in an air-tight glass-case along with an accurate barometer and thermometer.

Mr Adie has subjoined to the description of his instrument the opinion of a number of sea-faring people respecting its utility. Captain Ross, in his official report, says of it, that "it acts as a marine barometer, and is certainly not inferior in its powers. It has also the advantage of not being affected by the ship's motion, and of taking up very little room in the cabin. I am of opinion that the instrument will supersede the marine barometer when it is better known." Lieutenant Robertson observes, that "if it has any fault, it is that of being too sensible of small changes, which may frighten in a reef when there was no occasion for it; but, take it altogether, in my opinion it surpasses the mercurial barometer as much as the barometer is superior to having none at all."

*Thermometer.*—One of the most important of meteorological instruments is that which is employed for the measurement of temperature. It is constructed on the principle, that as all bodies have their bulk augmented by heat, the variations will be in proportion to the increase or diminution of that quality. It consists of a small glass tube (see Plate 128. Fig. 4.) having a very delicate bore, and one extremity blown into a bulb. This bulb, with part of the tube, is filled with a dilateable liquid, generally mercury, but sometimes alcohol; and if the instrument in this state be applied to a body warmer than itself, the liquid will be seen to ascend in the tube. In like manner, if the thermometer be applied to a body colder than itself, the bulk of the liquid being diminished, that portion of it which is in the tube will descend. Hence it is that this instrument becomes the measure of atmospherical temperature. Every increase or diminution of heat in the air produces in a thermometer exposed to it a corresponding expansion or contraction of the liquid which it contains; it only therefore remains to find out some method by which the indications of one thermometer may be compared with those of another. This is accomplished by means of a scale, the range of which has definite limits, and is divisible into a certain number of equal parts. The freezing and the boiling points of water are convenient stations in the thermometrical notation, and have been usually adopted to mark the boundaries of a certain range of calorific action. The scale may, of course, be carried as much below or raised as much above these limits as the uses of the instrument may happen to suggest.

Fahrenheit, whose name is usually associated with this instrument, began his scale 32° below the freezing point, or at what he conceived to be the greatest degree of cold that could possibly be produced. The boiling point, according to this division, is 212°, the difference between the one and the other being 180. This graduation is represented in Fig. 4. Plate 128.

The method adopted in France is more natural and convenient than that of Fahrenheit. The distance between the freezing and boiling points is divided into a hundred equal parts, the former being marked 0, the latter 100. It is known by the name of the Centigrade scale, and is usually attached to all instruments manufactured on the continent.

To reduce the notation of Fahrenheit into that of the centigrade, multiply the degrees of the latter by 9, divide the product by 5, and add 32 to the quotient. Thus, when the centigrade stands at 30, the scale of Fahrenheit will give 86; for 30 multiplied by 9, and divided by 5, produces 54; to which add 32, and the result is, as above, 86.

The convenience mentioned when describing the barometer has been more successfully attempted in regard to the thermometer; we mean the contrivance of self-registering. The instruments of this kind most commonly in use are of a very simple construction. Take one somewhat wider in the bore than ordinary, (Fig. 5. Plate 128.) and introduce a small bit of steel wire over *a*, the mercury, and lay the instrument in a horizonal position. As the temperature increases, the mercury rises and pushes forward the slip of steel; and when the mercury retires, in consequence of diminished temperature, the bit of metal remains at the highest point to which it had been raised, and denotes, of course, the greatest temperature which had occurred subsequently to the last observation.

Much care is necessary in using this instrument for meteorological purposes. It must be protected, not only from the direct rays of the sun, but even from the reflection of those rays, as well as from the frigorific influence of a very clear atmosphere, if the object of the observer be to obtain an accurate knowledge of the real temperature of the air. In truth, almost all the circumstances which affect the deposition of dew operate in deranging the indications of the thermometer; whence it follows, that the greater number of the meteorological tables which are from time to time presented to the public, have very small claims on their confidence as faithful registers of the proceedings of nature.

*Differential Thermometer.*—This instrument, invented by Mr Leslie and Count Rumford, is, as the former author describes it, a modification of the air thermometer, but susceptible of the impressions of heat only, and exempt altogether from the influence of the variations of atmospheric pressure. The tube to which the scale is applied, has a bore of equal calibre, from the 50th to the 15th part of an inch wide, the other branch being commonly wider; the terminating balls are not less than four tenths of an inch in diameter, and seldom exceeding an inch and a half. A glass tube terminated by a ball containing air, is joined hermetically, or by the flame of a lamp, to another larger tube, terminated by a similar ball containing air also, but including a small portion of some coloured liquid. The tubes are then bent, generally into a recurved or double stem like the letter U, and the liquid is adjusted to the proper height, by making bubbles of air pass from the one ball to the other, from the little enlargement of the bore at the junction of the tubes.

If both balls have the same temperature, the liquid must evidently remain stationary, but if the ball of the shorter tube be warmed, the air, suspending and exerting more elasticity, will depress the liquid in the stem; or if this ball be cooled, the air by its contraction, allows the liquid to ascend, from the superior elasticity of the air contained in the opposite ball. The fall or rise of the liquid will therefore mark the access of heat or cold in the adjacent ball and the space through which it moves will measure the precise difference of temperature. The main utility of this instrument in meteorological researches arises from the various modifications of which it is susceptible, and from the minute changes of temperature which it is fitted to detect. See Plate 128. Fig. 6.

*Hygrometer.*—The object of this instrument is to ascertain the amount of humidity in the atmosphere, and to measure the changes which take place in it with regard to moisture. As certain animal and vegetable substances are found to contract or to expand, when exposed to different degrees of moisture, the first hygrometers were made upon the direct principle which is here implied, and indicated the amount of humidity by the extent to which the fibres of any contractible substance was influenced by the atmosphere.

A more scientific instrument has been constructed on the following principle, namely, that, as evaporation produces cold, the effect of that process on a thermometer will indicate the rate and amount of evaporation, and consequently the relative moisture of the air. The more dry the air is, the greater will be the evaporation, and the greater also the cold, or the depression of the mercury in the thermometer.

The *hygrometer*, says Mr Leslie, has two distinct forms, the one portable and the other stationary. The former (See Fig. 7. Plate 128.) having its balls in the same perpendicular line, is protected by a wooden or metallic case, and fitted for carrying in the pocket, and two or three drops of pure water, from the tip of a quill or a hair pencil, being applied to the surface of the covered ball, and the instrument held exactly in a vertical position whenever it is used. The latter form (see Fig. 8.) is susceptible of rather greater accuracy, having its balls bent opposite ways at the same height. In some instances it is preferable to retain merely the simplest form of the differential thermometer as described above, the vertical stems being more distant, and the

# METEOROLOGY

*Fig. 1.*

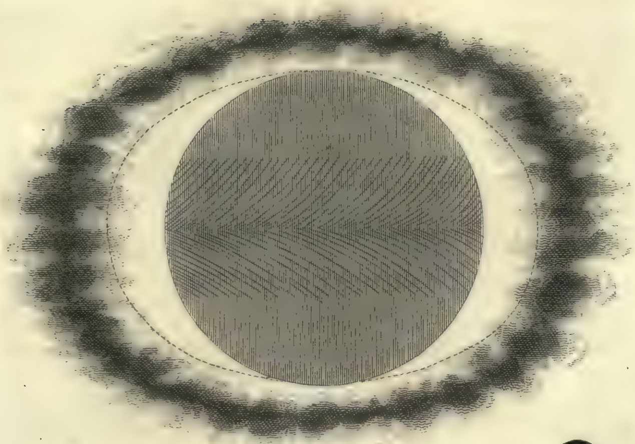
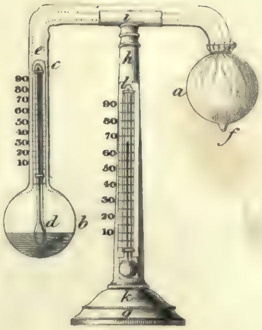


*Fig. 9.*



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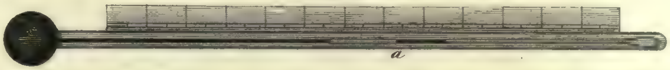

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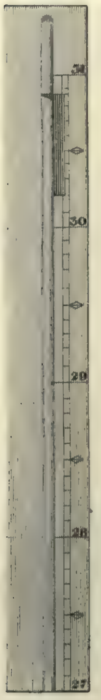

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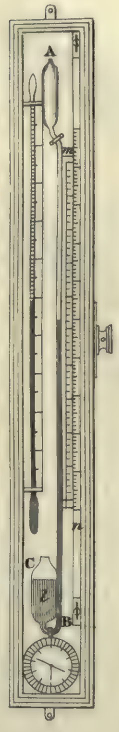

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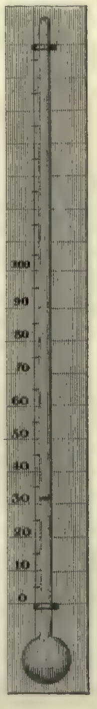

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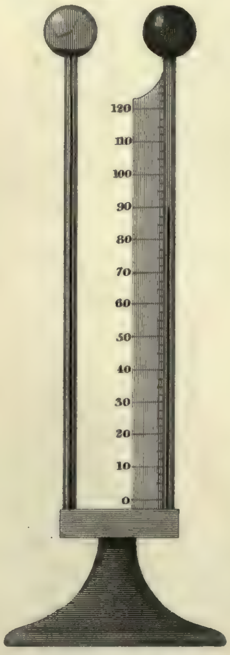

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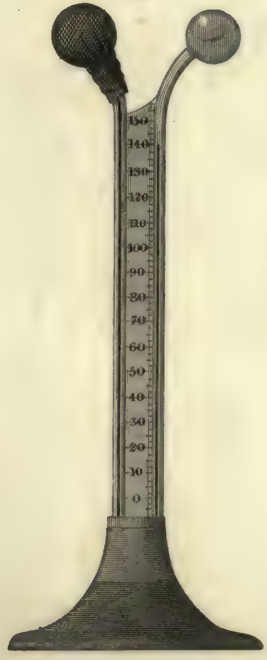

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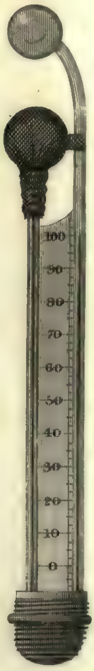


*Fig. 10.*

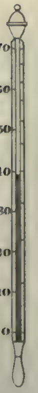


*Fig. 11.*

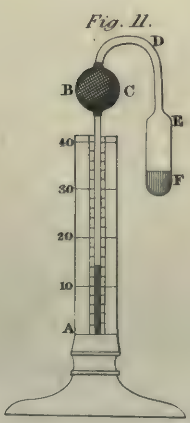


*Fig. 12.*

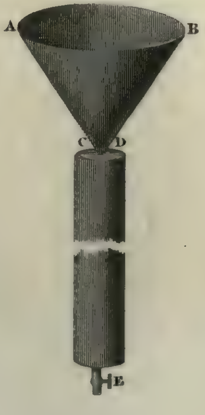


*Fig. 13.*

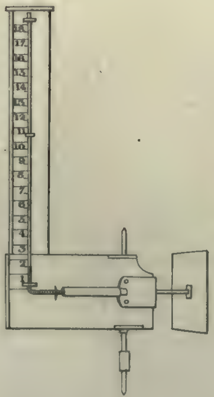
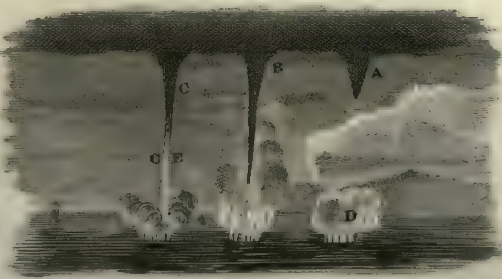


*Fig. 14.*



balls not reflected. In both these constructions, the two balls, since they occupy the same level, cannot be affected in the smallest degree by the unequal temperatures of the different strata of air inclosed in a close heated room. After the covered ball has been wetted, the instrument will continue to perform unimpaired, for the space perhaps of two or three hours. The addition of a few drops of water will then restore its action.

From the language here employed, the reader must already have perceived, that the hygrometer, having one of its balls covered with wetted silk, is acted upon by the cold produced by evaporation; which cold may be measured either on the common principle of the ordinary thermometer, or on that of the air-thermometer employed in the differential thermometer of Mr Leslie, or in the thermometrical hygrometer of Dr Hutton. The general doctrine is, that the dryness of the air in all circumstances is precisely indicated by the depression of temperature produced on a humid surface which has been freely exposed to its action.

In conducting meteorological observations, it has been found, that, instead of a hygrometer, two delicate thermometers answer the purpose equally well; having, indeed, the additional advantage of shewing the absolute as well as the relative temperatures of the two bulbs. The bulb of the one instrument is covered with silk kept constantly moist; and the difference of temperature between the two, expressed in tenths of a centigrade degree, gives the height of the hygrometer on the millesimal scale.

*Hygrometer by Daniell.*—We cannot leave this subject without adverting to an instrument, lately recommended to the meteorologist, by Mr Daniell of London. Its principal use, we think, must be confined to the indication of the dew-point, or that degree of temperature in the surrounding air at which it begins to deposit moisture. Fig. 9, Plate 128, represent this instrument:—$a$ and $b$ are two thin glass balls of $1\frac{1}{4}$ inch diameter, connected together by a tube, having a bore about $\frac{1}{8}$ inch. The tube is bent at right angles over the two balls, and the arm $b\,c$ contains a small thermometer $d\,e$, whose bulb, which should be of a lengthened form, descends into the ball $b$. This ball having been about two-thirds filled with ether, is heated over a lamp till the fluid boils, and the vapour issues from the capillary tube $f$, which terminates the ball $a$. The vapour having expelled the air from both balls, the capillary tube, $f$, is hermetically closed by the flame of a lamp.

This process is familiar to those who are accustomed to blow glass, and may be known to have succeeded after the tube has become cool, by reversing the instrument and taking one of the balls in the hand, the heat of which will drive all the ether into the other ball and cause it to boil rapidly. The other ball $a$ is now to be covered with a piece of muslin. The stand $g\,h$ is of brass, and the transverse socket $i$ is made to hold the glass tube in the manner of a spring, allowing it to turn and be taken out with little difficulty. A small thermometer, $k\,l$, is inserted into the pillar of the stand.

The manner of using the instrument is this: After having driven all the ether into the ball $b$, by the heat of the hand, it is to be placed at an open window, or out of doors, with the ball $b$ so situated as that the surface of the liquid may be upon a level with the eye of the observer. A little ether is then to be dropped upon the covered ball. Evaporation immediately takes place, which, producing cold upon the ball $a$, causes a rapid and continuous condensation of the etherial vapour in the interior of the instrument. The consequent evaporation from the included ether produces a depression of temperature in the ball $b$, the degree of which is measured by the thermometer $d\,e$. The action is almost instantaneous, and the thermometer begins to fall in two seconds after the ether is dropped. The artificial cold thus produced causes a condensation of the atmospheric vapour upon the ball $b$, which first makes its appearance in a thin ring of dew, coincident with the surface of the vapour. The degree at which this takes place is to be carefully noted, inasmuch as it is only by determining the relation which the temperature of deposition bears to the humidity of the atmosphere that Mr Daniell's instrument can serve the purpose of an hygrometer.

*Hygroscope.*—The object of this instrument is to detect the relative quantity of moisture which pervades the atmosphere from the absorption of it by certain fibrous substances. For example, from some experiments made by Mr Leslie, it appears that, under a like change of circumstances, 100 grains of ivory will attract from the atmosphere 7 grains of moisture; the same weight of boxwood 14 grains; of eider-down 16; of wool 18; and of beech 28. An attempt was lately made by the same ingenious philosopher to measure the expansion of absorbent cohesive substances by their enlargement of capacity when disposed into a thin shell. A piece of fine-grained ivory, about an inch and quarter in length, was turned into an elongated spheroid, as thin as possible, weighing only 8 or 10 grains, but capable of containing, at its greatest expansion, about 300 grains of mercury; and the upper end, which was adapted to the body by means of a delicate screw, had a slender tube inserted, 6 or 8 inches long, and with a bore of nearly the 15th part of an inch in diameter. (See Fig. 10, Plate 128.) The instrument being now fitted together, its elliptical shell was dipped into distilled water, or wrapped round with a bit of wet linen, and, after a considerable interval of time, filled with mercury to some convenient point near the bottom of the tube, where is fixed the beginning of the scale. The divisions themselves were ascertained by distinguishing the tube into spaces which correspond each of them to the thousandth part of the entire cavity, and equal to the measure of about three-tenths of a grain of mercury. The ordinary range of the scale included about seventy of those divisions. To the upper end of the tube was adapted a small ivory cap, which allowed the penetration of air, but prevented the escape of the mercury, and thereby rendered the instrument tolerably portable.

This hygroscope, the inventor tells us, was largely though rather slowly affected by any change in the humidity of the ambient medium. As the air became drier, it attracted a portion of moisture from the

Instruments.

shell or bulb of ivory, which suffering in consequence a contraction, squeezed its contained mercury so much higher in the tube. But if, on the contrary, the air inclined more to dampness, the thin bulb imbibed moisture, and swelled proportionally, allowing the quicksilver to subside towards its enlarged cavity. These variations, however, he candidly adds, were very far from corresponding with the real measures of atmospheric dryness and humidity.

The resources of science have not yet been rendered so far available as to convert a hygroscope into an accurate hygrometer; the former instrument, in its most improved state, denoting only the pressence of humidity in the air, but not its exact amount. Various substances have been applied for this purpose, such as rock-salt, potash, the muriate of lime, sulphuric acid, plates of slate-clay, or of unglazed earthen ware, the shavings of horn or of box, paper, parchment, and sundry other materials, which freely and copiously absorb moisture. But the weight which they gain by exposure is by no means proportioned to the real dampness of the air; and the rate of absorption, in particular, is found to increase in a most rapid progression as they approach to the point of absolute humidity.

*The Atmometer.*—This instrument has, from its use, been sometimes called the Evaporometer; the object contemplated in its structure being the measurement of the quantity of moisture exhaled from a humid surface in a given time. The atmometer invented by Mr Leslie consists of a thin ball of porous earthen ware, two or three inches in diameter, with a small neck, to which is firmly cemented a long and rather wide glass tube, bearing divisions, each of them corresponding to an internal annular section, equal to a film of liquid that would cover the outer surface of the ball to the thickness of the thousandth part of an inch. The ball and tube being filled with water, the top of the latter is covered with a brass cap, which, by means of a screw and collar of leather, is made quite air-tight, and the instrument is suspended out of doors, freely exposed to the wind. In this state the humidity exudes through the surface of the ball just as fast as it evaporates, and this waste is measured by the corresponding descent of the water in the stem.

Mr Anderson of Perth has invented an atmometer, which is thought to be, upon the whole, superior to that now described. It consists of a bent glass tube, A B C D E F, (Fig. 11.) of sufficient width to admit of a liquid moving easily from one part to another, and swelling out into the bulbs B C and E F. Into this tube, at A, is introduced a quantity of alcohol, which, after being conveyed into the bulb or wider tube, E F, is thrown into a state of ebullition; and while the steam is issuing from A, the tube is hermetically closed, so that the air is completely expelled from the space A B C D E. The bulb B C is then covered with moistened silk or paper, and the instrument freely exposed. In consequence of the pressure of the air being removed from the surface of the alcohol in the bulb E F, a portion of that liquid passes into vapour, and occupies the empty part of the tube. Were the whole of the instrument at the same temperature, this process would indeed be quickly stopped by the pressure of the vapour itself on the surface of the alcohol; but as the bulb B C has its temperature reduced by the external evaporation from the moistened silk or paper, the vapour which rises from E F is there condensed, and runs down in a liquid state into the tube A B. This distillation goes on more or less rapidly according to the degree of cold induced upon the bulb B C, that is, in proportion to the external evaporation; and, consequently, the quantity of liquid collected in the tube A B is the measure of that evaporation. When the atmosphere is completely saturated with moisture, or when the evaporation ceases, the temperature of A B will be the same as that of any other part of the tube; and the distillation, therefore, for the reason already stated, will also cease. The measure of evaporation thus found in inches and decimals of an inch is shewn by means of an attached scale, the divisions of which are determined by experiment.

*Rain-gage.*—This instrument is now known by various names, such as pluviameter, hyetometer, and ombrometer, from different Latin and Greek words which denote the measurement of rain. It has likewise a variety of forms; but that which we are now going to describe is not inferior to any that have hitherto been used.

It consists of a copper funnel, A B (Fig. 12.) five inches in diameter at top and inserted into a tube C D of the same metal, thirty inches in length and one and a half in diameter, furnished with a stopcock E at the lower end. It is examined at a fixed hour every day, and if rain has fallen during the last 24 hours, it is measured by letting it off through the stop-cock into F G, a glass tube of half an inch in diameter, with an attached scale of inches and tenths. By this means, the rain which falls on a circular area of five inches in diameter is collected on an area of half an inch; so that inches and tenths of water in the tube correspond to hundredths and thousandths of an inch of rain on the surface of the ground.

But we have already shewn that so much depends upon local situation, and even upon the difference of height in the the same locality, that the register of the best kept ombrometer will not afford accurate information in regard to the actual quantity of rain which falls in any given district in the course of a year. It gives, indeed, the relative quantity, and thereby enables us to compare the humidity of one season with that of another; and so far it is both a curious and a useful instrument.

*Electrometer.*—For an account of this instrument, as well as of the effect produced by electricity on the condition and currents of the atmosphere, we refer the reader to our article on that subject. Suffice it to observe, that the best apparatus of this kind is that invented by Bennet, which consists of two slips of thick gold leaf suspended from a knob within a small cylinder of glass, surmounted by a brazen cap. This may be connected with an insulated rod or wire extending a few feet beyond the window. Little reliance, however, for meteorological purposes, can be placed even on the most approved electrometer that has hitherto been used.

The *Drosometer*, or dew-measurer, is, in its best form, so imperfect an instrument, that it is hardly deserving of notice. The deposition of that meteor is affected by so many circumstances connected with the substance, as well as with the temperature of the body on which it lights, that no conclusion drawn from the most extensive experiments will be found applicable either to the atmosphere or the surface of the ground even in the immediate neighbourhood. The great difficulty of measuring dew arises from the fact that dew is *formed* by the substance on which it falls, and will therefore be more or less in quantity according to the properties of that substance, its relations to heat, and even the manner in which it is exposed. The reader who desires information on this subject will be amply gratified by perusing the valuable work of Dr Wells, to which we have alluded in a former part of this article.

*Anemometer, or Wind-gage.*—One of the earliest attempts in the construction of meteorological apparatus was to devise an instrument for indicating the force and velocity of the wind. It was usual, for instance, at one period, to employ a very small model of a wind-mill, and either to count the number of its revolutions in a given time, and thereby to form some estimate of the wind's motion, or to measure its power by the application of a weight to a conical barrel or axis. A more direct, and apparently a more scientific method, consisted in opposing to the wind the surface of a vertical plate of wood or thin metal, and in measuring the impulse of the aerial current by its effect in contracting a spiral spring. Such instruments, however, it is hardly necessary to observe, acted with such extreme irregularity that no reliance could be placed upon the results which were usually obtained.

This species of anemometer has been lately brought to the highest perfection of which it appears susceptible, by Mr Waddell of Hermitage-hill near Leith, who has also, in other departments of science, contributed not a little to the improvement of the most useful and ingenious instruments. It consists (see Fig. 13, Plate 128.) of a vertical plate of wood, four or five inches in diameter, which, as the whole instrument is so contrived as to act the part of a vane, always presents its face to the wind, and receives its full pressure. To the centre of the plate a rod is attached, which being introduced horizontally into the lower end of a bent tube partially filled with quicksilver, works like a piston in raising that fluid according to the force of the wind. The tube is from 15 to 20 inches long, having a bore of the twentieth part of an inch; and that the instrument may register its own movements, a small steel mark rises with the mercury, and, adhering to the sides of the tube, remains, after the wind has subsided, to denote the highest point to which the column had ascended during any given period.

A scale is attached to measure the ascent of the mercury in inches and decimals; and it is obvious that the height in every instance, diminished in the ratio of the surface of the plate to the section of the bore in the tube, will give the force of the wind, though not its actual velocity. Mr Waddell has hitherto found it impossible to reduce the force into velocity, no such relation having been discovered between the one and the other as to point out the separate amount of each on any known standard. Could the rate of motion be measured at any one velocity, it could easily be measured at all other velocities; but as yet philosophy has not been able to determine a unit with which to begin the scale.

The most common form of the anemometer, however, is that which was borrowed from the French by Dr Lind, and which is employed to measure the force of the wind by marking the height to which it raises a column of water in a bent tube, as denoted by an experimental scale. Professor Leslie, to whom the meteorologist stands very much indebted in most departments of the science, has proposed a species of anemometer which acts on a different principle. It is calculated to measure the rate of the wind's motion on the ground of a fact which will not be disputed, namely, that the cooling power of a stream of air is proportional to the velocity of that stream. The instrument consists of a common spirit of wine thermometer, having a pretty large bulb, and the force of the wind is deduced by an easy calculation from the time which it takes to cool through a certain number of degrees; the temperature having been artificially raised to suit the experiment. The coincidence between the results derived from Dr Lind's anemometer compared with those supplied by Dr Leslie's is said to be very striking; affording, at least, an approximation to the knowledge of a phenomenon which is not perhaps capable of philosophical precision.

The main difficulty, as we have already remarked, in regard to all this kind of apparatus is the formation of a scale, founded on an experimental determination of the wind's velocity, at any one rate of motion, and the measurement of that rate in miles. If any velocity could be ascertained, all others within the range of the scale would admit of an easy calculation; but we are not satisfied that, by means of any anemometer hitherto employed, the speed at which the air moves has been reduced to any known standard.

### ON METEORITES.

Leaving Meteorology, properly so called, we proceed to give a brief account of another species of atmospheric productions, which, from being less common than rain, hail, and dew, have always been regarded with much more curiosity and wonder. In the article GEOLOGY we have alluded to meteoric stones as one of the species of native iron; giving the result of the most careful analysis of these bodies, and stating generally the insuperable difficulties which attend every hypothesis which has been devised for explaining their origin. We shall now proceed to give an outline of the more plausible opinions which have been entertained on the latter subject; and then lay before the reader a list of some remarkable cases, collected by the industry of Chladni and others, which will illustrate at once the frequency of the phenomenon in question, and the precise character which it has presented in every particular instance.

We may observe, in the outset, that these stones all resemble one another, and are different from any ferruginous compound hitherto discovered on the crust of our globe. Their outer surface is rough, and covered with a black crust. When broken, they appear of an ash-grey colour, and of a granular texture like a coarse sand-stone. When examined with a microscope, four different substances may be discovered of which they are composed: 1st, A number of spherical bodies, varying in size from a pin-head to a pea, of a greyish-brown colour, opaque, breaking easily in every direction, of a compact texture, capable of scratching glass, and of giving a few feeble sparks with steel. 2d, Fragments of pyrites, of an indeterminate shape, of a reddish-yellow colour, granular, and easily reduced to powder. The powder has a black colour. 3d, Grains of iron in the metallic state, scattered, like the pyrites, through the stone. 4th, The three substances just mentioned are cemented together by a fourth of an earthy consistence, and so soft that all the other substances may be easily separated by the point of a knife or the nail, and the stone itself crumbled to pieces between the fingers. This cement is of a grey colour. Chromium, it is said, has been detected as one of the ingredients of meteoric stones; and some experimenters have maintained that lime, alumina, and manganese have appeared in the course of their analysis. In every instance, however, of a well-authenticated meteorite, *nickel* is found as one of the constituent parts; a circumstance which distinguishes the atmospherical production from every other description of metallic mineral.

From the analyses performed by Howard, Klaproth, and Vauquelin, we learn, that the black crust consists of a compound of iron and nickel, partly metallic and partly oxydised. The pyrites consists of iron, nickel, and sulphur. The metallic grains consist of iron combined with about one-third of its weight of nickel, and the yellow globules are composed of silica, magnesia, iron, and nickel. The earthy cement consists of the very same substances, and nearly in the same proportion as the globular matter.

These stony bodies when found are always hot, and commonly bury themselves by their fall some depth under ground. Their size differs from a few ounces to several tons. They are usually roundish, covered, as has been said, with a black crust, and, in many cases, smell strongly of sulphur. Most of them, too, have been preceded in their descent by the appearance of luminous bodies, or meteors of a more ordinary nature. An explosion is commonly heard, and then the stone, or shower of stones, falls to the earth. Sometimes these substances continue luminous till they sink into the ground. It has been remarked, moreover, that the meteors move in a direction nearly horizontal, and seem to approach the earth before they explode.

As philosophy is in general somewhat incredulous respecting all wonders which rest on tradition or on mere popular authority, the fact of meteoric stones having actually reached the ground was for a long time obstinately disputed by the learned. At length, when scepticism was completely vanquished by a multitude of well attested cases, the chemist and meteorologist found themselves compelled to have recourse to their ingenuity in order to account for so striking a phenomenon; and as nothing costs less trouble than an hypothesis, the world was soon supplied with a great variety of very bold, very groundless, and very inconsistent opinions.

It was first supposed that the bodies in question were thrown up into the atmosphere from the mouths of volcanoes, and were afterwards precipitated by their own weight to the surface of the earth; but the immense distance from all volcanoes at which they have been found, and the total absence of all similar stones in such volcanic productions as have been examined in almost every part of the world, soon rendered this opinion altogether untenable. M. Chladni of Wirtemberg endeavoured to prove that the meteors from which they fell, or rather by which they were accompanied, were bodies floating in space, unconnected with any planetary system; were attracted by the earth in their progress, and kindled by their rapid motion through the atmosphere. But this opinion is not susceptible of any direct evidence, and has, accordingly, a very weak hold on philosophical belief. Laplace, again, it is well known, suggested the probability that they were launched forth by the volcanoes of the moon; and he, Poisson, and Dr Hutton, have demonstrated the abstract proposition, that a heavy body projected with the velocity of about 6000 feet in a second may be driven beyond the sphere of the moon's attraction into that of the earth. But the existence of volcanoes in the moon is purely hypothetical, while the appearance of the meteors which accompany the fall of the stones, and the swiftness of the horizontal motion of these luminous bodies, militate very strongly against such an hypothesis. The greatest number of philosophers, with Mr King and Sir William Hamilton, consider them as concretions actually formed in the atmosphere; an opinion which Dr Thomson thinks the most probable of all, though he admits that, in the present state of our knowledge, it would be absurd to attempt to explain the manner in which they are formed.

Recent inquirers do not incline to rest satisfied with the conclusion which has just been stated. It has been supposed, accordingly, that meteoric stones are portions of small invisible planets which revolve round the earth, or that they are fragments of a large planet which formerly existed between Mars and Jupiter, and of which the four small planets, Ceres, Pallas, Juno, and Vesta, are the remaining fragments; or, lastly, that they are minerals in their primitive state, which are ejected from the interior of our own globe, by volcanoes situated in the polar regions, which produce, at the same time, the phenomena of the northern lights.

Professor Leslie, we think, from a hint which he somewhere throws out, appears to hold the opinion which was supported by Dr Reynolds in relation to this subject. It is supposed that minute portions of the earthy and metallic matters which compose the surface of the earth, being exposed to the sun's influence, are volatilized by the absorption of heat, and thereby assuming the state of elastic fluids, ascend until they arrive at media of their own density; where, congregating into immense and highly concentrated volumes, they explode and exhibit all the appearances of meteoric stones and showers. It is easy to state objections to any theory which has the bare support of analogy and general principles upon which to rest its claims; but we are satisfied, notwithstanding, that the most philosophical views on this subject are those which regard all metallic and earthy meteors as being composed of gaseous exhalations from different parts of the earth.

But our limits remind us that we must no longer indulge in theoretical speculations. In regard, again, to a selection of cases illustrative of the stoney meteorites, we shall content ourselves with one which happened in our own times, and almost in our immediate neighbourhood. We allude to the occurrence which took place at Possil, near Glasgow, on the 5th day of April, in the year 1804.

On the day now specified, sixteen men were at work in a stone quarry, when they heard a noise which was first like the discharge of artillery, and then like the rumbling of stones down a precipice, and lasting, in the whole, about the space of a minute. Three men in an adjoining field compared the noise likewise to the firing of cannon, which was immediately succeeded by a sound similar to that of a bell, or rather of a gong, with a violent whizzing in the air; and, lastly, they heard a sound like that of a hard body struck forcibly against the ground. The overseer of the quarry, and a man who was on a tree, described the noise as if continuing about two minutes, and resembling the sounds already mentioned. A dog which was on the spot ran home in apparent terror. The overseer, greatly alarmed at what he called a misty commotion in the atmosphere, exclaimed to the man on the tree, "Come down, I think there is some judgment coming upon us!" His friend had scarcely reached the ground, when something struck with great force into the bottom of a drain, at the distance from them of about ninety yards, splashing mud and water for twenty feet round. One of two boys who were present observed the appearance of smoke in the air, and something of a reddish colour moving rapidly from the west till it fell on the ground. A moment before the stroke on the earth was heard, the other boy called out, "O sic a reek!" alluding to the smoke which he saw near the place where the body fell. The overseer, upon running to this spot, observed a hole in the bottom of the drain, which was fast filling with water; about six inches of it remained still empty, and at the bottom of the hole he felt something hard which he could not move with his hand. With the assistance of a shovel and mattock, he brought to light two pieces of stone, which had penetrated about eighteen inches below the bottom of the drain, the hole being about fifteen inches in diameter. One of the pieces was about two inches long, the other about six inches long, four broad and four thick, and blunted at the edges and end. The fractures of the two exactly coincided, but he could not say whether they had been separated by the mattock or in consequence of the fall. As he conceived them to be merely pieces of whinstone, he threw them carelessly away; and it was not till after a diligent search, made after the lapse of a few days, that the smaller fragment was recovered. A portion of this meteorite is deposited in the Hunterian Museum in the university of Glasgow; and it is worthy of remark, that, both in its constituent parts and in its external characters, it corresponds exactly with other specimens found in the most remote regions of the earth.

We should leave this branch of the subject imperfect, if we did not mention the phenomenon of the water-spout,—an appearance which has long been reckoned one of the most curious and perplexing in meteorology. Some philosophers have described the water-spout as being of electrical origin; while others have considered them as produced solely by the mechanical action of a whirlwind. The accounts hitherto given of this meteor have not been either so sufficiently numerous or distinct as to supply us with confident data for deciding this question. There can be no doubt, however, that water-spouts have, in most cases, been accompanied with electrical phenomena; and it is equally certain, that the spiral motion of the water has been produced by a gyratory movement in the air, arising from the meeting of two opposite winds.

The 14th figure, in Plate 128, represents the different states of a water-spout, as they were observed by an intelligent navigator in a tropical latitude.

At their first formation they appear at A, where the black cloud drops from a level surface into a conical form, before the disturbance at the surface of the sea is shewn at D, where the effect produced is like that of a smoking furnace. The black conical cloud now continues to descend, as shewn at B, till it almost reaches the surface of the sea, and the smoke-like appearance rises higher and higher, till it forms a union with the cloud from which the spout appears to be suspended. In this situation it is said to put on its most terrific appearance to the mariners who have the misfortune to be in its neighbourhood. When the spout begins to disperse, it assumes the appearance shewn at C. The black cloud generally draws itself up in a ragged form, but leaves a thin transparent tube C, E, which reaches to the water, where the smoke-like commotion continues to prevail.

It is remarked by another observer, (Phil. Trans. 1702, p. 1077.) that water-spouts in general, but particularly those of the pillar kind, began towards the end to appear like a hollow canal, only black in the borders but white in the middle; and though at first they were only black and opaque, yet one could very distinctly observe the sea-water to fly up along the middle of this canal, as smoke does up a chimney, and that with great swiftness and a very perceptible motion. Soon after the spout or canal burst in the middle, and disappeared by little and little.

We conclude this article with an extract from the Edinburgh Philosophical Journal, containing a list of the more remarkable meteorites of which an authentic record has been preserved.

### *Masses of Iron supposed to have fallen from the Heavens.*

#### *Spongy or Cellular Masses containing Nickel.*

1. The mass found by Pallas in Siberia, to which the

Tartars ascribe a meteoric origin.—*Voyages de Pallas*, tom. iv. p. 545. Paris 1793.

2. A fragment found between Eibenstock and Johanngeorgenstadt.
3. A fragment propably from Norway, and in the imperial cabinet of Vienna.
4. A small mass weighing some pounds, and now at Gotha.
5. Two masses in Greenland, out of which the knives of the Esquimaux were made.—See Ross's *Account of an Expedition to the Arctic Regions*.

*Solid Masses where the Iron exists in Rhomboids or Octohedrons, composed of Strata, and containing Nickel.*

1. The only fall of iron of this kind, is that which took place at Agram in 1751.
2. A mass of the same kind has been found on the right bank of the Senegal.—*Compagnon, Forster, Goldberry.*
3. At the Cape of Good Hope: Stromeyer has lately detected cobalt in this mass.—*Van Marum* and *Dankelman*; *Brande's Journal*, vol. vi. 162.
4. In different parts of Mexico.—*Sonneschmidt, Humboldt*, and the *Gazette de Mexico*, tom. i. and v.
5. In the province of Bahia in Brazil. It is seven feet long, four feet wide, and two feet thick, and its weight about 14,000 lb.—*Mornay* and *Wallaston*, *Phil. Trans.* 1816, p. 270, 281.
6. In the jurisdiction of San Jago del Estera.—*Rubin de Cœlis*, in the *Phil. Trans.* 1788, vol. lxxviii. p. 37.
7. At Elbogen in Bohemia.—*Gilbert's Annal.* xlii. and xliv.
8. Near Lenarto in Hungary.—*Ditto*, xlix.

The origin of the following masses seems to be uncertain, as they do not contain nickel, and have a different texture from the preceding:

1. A mass found near the Red River, and sent from New Orleans to New York.—*Journ. des Mines* 1812, *Bruce's Journ.*
2. A mass at Aix-la-Chapelle containing arsenic.—*Gilbert's Annals*, xlviii.
3. A mass found on the hill of Brianza in the Milanese.—*Chladni* in *Gilbert's Annal.* L. p. 275.
4. A mass found at Groskamdorf, and containing, according to Klaproth, a little lead and copper.

*List of Falls of Dust and other Substances, either of a soft, dry, or humid nature.*

P. C. 472, Nov. 5. or 6. A great fall of black dust took place at Constantinople, during which the heavens seemed to burn.—*Procopius, Marcellinus, Theophanes, &c.*

652. A shower of red dust fell at Constantinople.—*Theophanes, Cedrenus.*

743. Dust fell in different places, accompanied with a meteor.—*Theophanes.*

*Middle of the 9th century*, red dust, and matter like coagulated blood, fell from the heavens.—*Kazwini, Elmazen.*

929. A fall of red sand took place at Bagdad.—*Quatremere.*

1056. Red snow fell in Armenia.—*Matth. Eretz.*

1110. A burning body fell in the Lake of Van in Armenia, and made its waters blood red. The earth was cleft in several places.—*Matth. Eretz.*

1416. Red rain fell in Bohemia.—*Spangenberg.*

In the same century, matter like coagulated blood fell along with a stone at Lucerne.—*Cysat.*

1501. According to several chronicles, a shower of blood fell at several places.

1548, Nov. 6. A red substance like coagulated blood, fell with a meteor, probably in Thuringia.—*Spangenberg.*

1560. On the day of Pentecost, red rain fell at Embden and Louvaine.—*Fromond.*

—— Dec. 24. A meteor and red rain fell at Lillebonne.—*Natalis Comes.*

1586, Dec. 3. Red and black matter fell at Verde in Hanover, with thunder and lightning.—*MSS. of Salomon.*

1591. A shower of blood fell at Orleans.—*Lemaire.*

1618, Aug. A shower of blood, stones, and a meteor, fell in Styria.—*De Hammer.*

1637, Dec. 6. Much black dust fell in the Gulf of Volo and in Syria.—*Phil. Trans.* i. p. 377.

1638. Red rain fell at Tournay.

1640, Oct. 6. Red rain fell at Brussels.—*Kronland* and *Wendelinus.*

1645, Jan. 23. or 24. Red rain fell at Bois-le-duc.

1689. Red dust fell at Venice, &c.—*Valisnieri.*

1711, May 5. and 6. Red rain at Orison in Sweden.—*Act. Lit. Sueciæ*, 1731.

1718, March 24. Gelatinous matter fell, with a globe of fire, in the isle of Lethy in India.—*Barchewi.*

1719. Sand fell in the Atlantic, latitude 45° N., and longitude 322° 45′ from Paris.—*Mem. Acad. Par.* 1719. *Hist.* p. 23.

1744. Red rain fell at St Pierre d'Arena near Genoa.—*Richard.*

1755, Oct. 20. Black dust fell in Shetland, particularly at Scalloway. It was like lamp black, and smelt strongly of sulphur.—*Phil. Trans.* vol. i. p. 297.

—— Nov. 13. The sky was red, and red rain fell in different countries.—*Nov. Act. Nat. Cur.* tom. ii.

1763, Oct. 9. Red rain fell at Cleves, Utrecht, &c.—*Mercurio Hist. y Polit.* Madrid, Oct. 1764.

1765, Nov. 14. Red rain fell in Picardy.—*Richard.*

1781, April 24. Count Gioeni observed, in the third region of Mount Ætna, every thing "to be wet with a coloured cretaceous grey rain," which, after evaporation, left every place covered with it to the height of two or three lines. All iron-work touched by it became rusty.—*Phil Trans.* 1782, vol. lxxii. p. 1.

1796, March 8. A viscous matter fell along with a meteor in Lusatia. It had the colour and odour of dried brown varnish, and is supposed by Chladni to consist of sulphur and iron. *Gilbert's Annal.* lv.

1803, March 5. and 6. A shower of red snow or dust, fell at Pezzo, at the extremity of the Valle Camonica. It was preceded by a violent wind on the 5th. A similar shower fell in Carniola on the same days, and another shower of a rose colour fell over the whole surface of Carnia, Cadore, Belluno, and Feltri, to the height of five feet ten inches. White snow had previously fallen, and the red shower was again succeeded by white snow. The colouring matter consisted of silex, alumina, and oxide of iron.—*Opuscoli Scelti*, tom. xxiii. *Journ. de Physique*, Ap. 1804; and *Giornali di Fisica*, Nov. 9. Dec. 1818.

1813, March 13. and 14. Much red dust, red snow, and red rain, fell in Calabria, Tuscany, and Friuli, at the time of the fall of meteoric stones at Cutro. Snow and hail of a yellow-red colour fell over all Tuscany, with a north wind. Snow, of a brownish-yellow colour, fell at Bologna, the wind being south-west. — *Bibl. Brit.* Oct. 1813, and April 1814. According to Sementini, this dust contained,

| | | | | | |
|---|---|---|---|---|---|
| Silex, | - | 33 | Chrome, | - | 1 |
| Alumina, | - | 15½ | Carbon, | - | 9 |
| Lime, | - | 11¼ | Loss, | - | 15¾ |
| Iron, | - | 14½ | | | |
| | | | | | 100 |

1814, July 3. and 4. A great fall of black dust took place in Canada, with the appearance of fire.—*Phil. Mag.* xliv. 191.

—— Nov. 5. In the fall of meteoric stones in the Doab, each stone was found to be surrounded with a mass of dust.—*Phil. Mag.*

1815. About the end of September, the South sea was covered with dust to a great extent.—*Phil. Mag.* July 1816, p. 73.

1816, April 15. Brick red snow fell on Tonal and other mountains in Italy. The earthy powder was composed of

| | | | | | |
|---|---|---|---|---|---|
| Silex, | - | 8 grains. | Empyreumatic oil, | | 2 |
| Iron, | - | 5 | Carbon, | - | 2 |
| Alumina, | - | 3 | Watery ingredients, | | 2 |
| Lime, | - | 1 | Loss, | - | 2·25 |
| Carbonic acid, | | 0·05 | | | |
| Sulphur, | - | 0·25 | | | 26. |

For a farther account of similar occurrences, we refer to the first volume of the periodical work, from which we have taken the above quotation; and for the general doctrines and facts of meteorology, we recommend to the reader a careful study of De Luc; Wells *on Dew*; Leslie *on Heat and Moisture*; Dalton's Papers; Daniell's *Essays*; and Foster *on Atmospherical Phenomena.*

Meteoromancy. ‖ Methodists.

METEOROMANCY, a kind of divination which passed from the Tuscans to the Romans, who are said to have held it in high estimation. It was performed by meteors, and chiefly by lightning and thunder.

METHEGLIN, a species of liquor described under Mead. The term is Welsh, *Meddyglen*, and of the same import in Wales. See Mead.

METHODISTS, an ancient sect of physicians at Rome, who were so called from the peculiar manner in which they treated their patients. The term is also applied to a species of polemical divines in the Romish church.

METHODISTS, the appellation of a considerable religious community, which had its origin at Oxford in 1729, chiefly under the auspices of the celebrated Mr John Wesley. This gentleman being then a fellow of Lincoln college, was, together with his brother Charles, Mr Morgan commoner of Christ church, and Mr Kirkham of Merton college, in the habit of devoting certain evenings every week to prayers, and the reading of the original scriptures. This small body being afterwards joined by Mr Ingham of Queen's college, Mr Broughton of Exeter, Mr James Hervey, and latterly, by Mr George Whitefield, was soon remarked for that peculiarly systematic deportment which suggested, together with other sarcasms, the epithet of *Methodists*, in allusion to the ancient Methodistæ who practised medicine by method, in opposition to quackery. Deeply affected with the contemptuous sneers thrown upon himself and associates, Mr John Wesley was induced to apply for counsel, in a letter to his venerable father, then rector of Epworth; and in return, received a most encouraging reply. That abusive obloquy which effectually discouraged some of the members, now ceased to disturb the tranquillity of Mr Wesley, and his more decided associates; and he himself, in particular, by his judicious conduct and remarkable progress in learning, in some degree abashed his opponents. Subsequently to the death of his father, Mr John Wesley was advised to proceed to Georgia to preach to the Indians; and he accordingly engaged in that laudable enterprize in 1735, but circumstances soon occasioned his return to England; and Mr George Whitefield being, in consequence, appointed to succeed him, had the happiness of finding his indefatigable labours attended with the greatest success.

Methodists.

Mr Wesley's public discourses, after his return from America, brought him very many followers, and a small society for spiritual improvement, similar to that at Oxford, was now instituted by his converts,—the peculiarities of which association may be viewed as the basis of Methodism. These converts agreed to meet once a week in *bands*, or companies of from five to ten persons, for the purpose of consulting freely respecting the state of their hearts, &c. They instituted a weekly conference for all the bands, to be observed on Wednesday evenings. At these conferences, such as wished to be admitted into their society were, preparatory to their trial, thus catechised:—*What are your reasons for desiring this? Will you be entirely open, using no kind of reserve? Have you any objections to any of our orders?* Every fourth Saturday was appointed by them for a day of general intercession, and the ensuing Sunday sennight was set apart for a general *love-feast*. Thus was established, by Mr Wesley, one of the most extraordinary religious sects of ancient or modern times.

As professed Arminians, the Methodists question the certainty of the saints' perseverance; and while they admit that certain persons and churches have been elected, and that great events are fore-ordained, they reject the doctrine of election as inculcated by the Calvinists. Their decided principles are salvation by faith in Jesus Christ; perceptible, and, in some instances, immediate conversion; and an assurance of reconciliation to God, which they imagine is inseparably connected with the new birth.

When Mr John Wesley and Mr George Whitefield came to differ in their religious sentiments, the Methodists were, in consequence, divided into two parties, the Calvinistic and the Arminian, though the term *Methodists* was more generally applied to the followers of Mr John Wesley, and his coadjutors. Two partial separations from the Methodists have likewise occurred. These are the *New Itinerancy* under Mr Alexander Kilham, and the society of *Revival Methodists.* The latter constitute a considerable body of the Wesleyian Christians, particularly in Liverpool, Macclesfield, Manchester, Stockport, Preston, and Leeds. The *Revivalists* in Macclesfield are a distinct and numerous body, and have published their *general rules*, together with a declaration of doctrines. The most prominent trait in this society, is their unrestrained freedom of indulging in prayer and praise,—a privilege of which they avail themselves even in time of sermon, and which they often express by sighs and groans.

The success of the Methodists, first under the labours of Mr Wesley, and afterwards under those of Mr George Whitefield, was truly astonishing. This last individual, with indefatigable zeal, travelled over the greater part of the continent of North America, to which he made no less than seven voyages, visiting the various colonies of Virginia, Maryland, North and South Carolina and Georgia. He also visited the Bermuda islands, England and Wales, Scotland and Ireland; in all which places he preached to vast multitudes with the most astonishing success. During this period, from 1739 to 1769, the Methodists flourished under the indefatigable labours of these two illustrious preachers, although some of the most scandalous and cruel outrages were, to the disgrace of the English, committed against Mr Wesley and his followers, which they bore with the most exemplary patience and non-resistance; and notwithstanding this opposition, their numbers daily increased, particularly in England and Ireland.

It is remarkable that this widely disseminated sect of Christians has had comparatively less success in Scotland than in other quarters of the world, insomuch that a conference was some time ago held on the subject. But Methodism is perhaps not perfectly well suited to the natural disposition of the inhabitants of North Britain, and the residence of an enlightened clergy may have a great effect in preventing innovations. By the erection of handsome chapels, however, and the great attention they pay to the improvement of sacred music, they are likely to increase their numbers. But in England, Wales, and America, the Methodists have deservedly experienced unparalleled success. From the account of their 76th annual conference at Bristol in 1819, it appears that, in the preceding year, an accession had been gained of 6905. Their stations in Britain amount to 318, each of which employs two, three, or four preachers; in France they have four missionary stations; in Brussels one; in Gibraltar one; in Ceylon and continental India about twenty; in Africa six; in the West Indies above forty; and in the British provinces of North America forty-five.

In conclusion, it may be remarked, that while the Methodists are obviously not without their defects and errors, they are certainly praiseworthy for their animated zeal, both at home and abroad, in the propagation of the gospel; and it cannot be doubted, that their ministry has been attended with advantageous consequences to society, by reclaiming the abandoned and vicious. The reader who desires further information on this subject, is referred to Myle's *History of the Methodists*; *Wesley's Life*, by Coke and Moore; Wesley and Coke's *Journals*; *Christian Observer*, Vol. III.; *Arminian Magazine*, and *Quarterly Review*.

METHUSELAH, one of the ancient patriarchs, son of Enoch, and father of Lamech, born A.M. 687, and died A.M. 1656, at the astonishing age of 969 years, which far surpasses that of any other human being that ever lived.

METONYMY in rhetoric, is a trope by which the significant circumstances of a thing are put for the thing itself; or it consists in putting the effect for the cause, or the subject for the adjunct. Virgil thus says in his Æneid,—"They lie down upon purple,"—implying that they lie on couches dyed with purple.

METOPOSCOPY, a suppositional art of deciphering the peculiar propensities of individuals, by an examination of the traces and lines in the face. This subject, which may be considered as a particular branch of physiognomy, has been illustrated by Ciro Spontoni, who speaks of seven lines in the forehead, the first of which being governed by Saturn, the second by Jupiter, the third by Mars, and the rest by their particular planets.

METRE, in poetry, is a system of feet of proper length. The heroic verse, consisting of five long and five short syllables, is very generally adopted; but poets being at full liberty to introduce any form of verses they may fancy, the metres in English versification are exceedingly various.

METROPOLIS, from the Greek, signifying *mother* and *city*, is the capital or chief town of a country or province. An archiepiscopal church is likewise so denominated. To each province, and each diocese, belonged a metropolis, or capital city, in the Roman empire; and to this division, in course of time was adapted that of the ecclesiastical. The bishop of the capital city possessed the title of metropolitan, and held a pre-eminence over all the bishops of the province. About the third century, this erection of metropolitans took place, and was afterwards confirmed by the council of Nice.

METZ, a city of France, and capital of the department of Moselle, is situated at the junction of the Seille and Moselle, and consists of the Old and New Town, both of which are spacious, but more particularly the latter. It is very strongly fortified, and has three citadels. The cathedral is among the finest in Europe. The Jews are numerous in this place, and have a synagogue.

MEURTHE, a department in the north-east of France, and one of the richest in the kingdom, is bounded on the north by the department of the Moselle, on the west by the Netherlands, on the south by the department of the Vosges, and on the east by that of the Lower Rhine; and is watered by the rivers Meurthe, Seille, Sare, and Veszouze. It produces corn, wines, tobacco, hemp, saffron, and madder. The forests occupy 445,000 acres, and

Meurthe likewise contains several iron mines, marble and stone quarries, and salt springs. Glass and earthen ware are the chief manufactures. The principal towns are Nanci, the capital, Luneville, Toul, Chateau, Selins, and Sarrebourg. The population has been stated at 342,107.

MEXICO, or NEW SPAIN, a kingdom of vast extent in North America, and the most considerable of the nine great governments into which the Spanish possessions in the New World have been divided, is situated between 7° and 32° of north latitude, and between 81° and 110° of west longitude, and extends about 610 leagues in length, and 364 in breadth.

*General aspect.*—The aspect of this extensive region is very mountainous, though it presents numerous elevated plains, intermixed with fertile valleys. The groups of mountains in the interior are of great extent and elevation, and the most lofty are those bordering on the coast of the Pacific ocean. The burning volcanoes are five in number, but eruptions and earthquakes are comparatively of rare occurrence. Owing to the extreme height of the surface above the level of the sea, the climate of the greater part of the country is temperate and salubrious rather than sultry. The occasional cold breezes experienced on the eastern coast, essentially contribute to moderate the intolerable heats of that quarter; while, on the western coast, the air is remarkably hot and prejudicial to health. In the central table land the winters are rather severe; but as to climate, soil, and vegetation, the equinoctial regions of New Spain are similar to the temperate zones. From the month of June to September, the rainy season generally prevails between the 22d and 30th degree of north latitude.

*Rivers and lakes.*—Mexico is rather insufficiently supplied with navigable rivers, the Rio Bravo del Norte, the Rio Colorado, and the Rio de Santiago, being the chief; but the lakes are numerous, and very considerable. In the intendancy of Valladolid, the lake of Patzcuaro is singularly picturesque, while those in the valley of Mexico occupy a fourth part of the district.

*Natural history.*—In consequence of the remarkably diversified climate of New Spain, the country affords a vast variety of plants, which are a source of boundless investigation to the botanist. The produce of grain, fruits, and roots is also immense, and the cultivation of cotton, sugar, and coffee, in which the inhabitants are very successful, is found to be a very lucrative concern. The indigo and cocoa brought from this quarter is of superior quality, and, always commands a ready sale. Since the 16th century, domestic animals, particularly oxen, horses, mules, sheep, and hogs, have greatly multiplied; and along the eastern coasts, vast herds of horned cattle graze on the richest pastures. These are valued chiefly for their tallow and hides, milk, butter, and, cheese, being but little used by the natives. As a proof of the great abundance of cattle and horses, from 30 to 40,000 of the former are said, not unfrequently, to range in herds together over the vast plains, and they are killed merely for the sake of their hides, which are exported to Europe. Horses are also suffered to run wild, and are very numerous; and of the mules, which are still more plentiful, the city of Mexico alone employs upwards of 5000 for drawing carriages, while the commerce of Vera Cruz requires yearly about 70,000 of these useful animals. Among the other quadrupeds are the deer, fox, bear, wolf, jaquar, and puma. The varieties of birds vying in the richness and beauty of their plumage, are manifold; and of the European poultry, the goose is the only species not found in these territories. The rearing of the cochineal insect has been long a branch of industry; the silk-worm was formerly much attended to, but only a few native caterpillars are now retained, the silk of which, called *misteca*, being of inferior quality; bees likewise have become an important object of attention, chiefly for the produce of wax, which is in great request for the Catholic worship. The whale fishery is prosecuted to a considerable extent on the western coast, and pearls are obtained in the gulf of Panama, and on the eastern coast of California.

*Mineral productions.*—The mines of Mexico have greatly promoted the prosperity of this country, while, at the same time, they have been productive of incalculable evils. Almost all of them are situated on the ridge or the western slope of the Cordillera of Anahuac; and the average annual produce of the whole is 2,500,000 marks of silver, and 700 marks of gold. The districts of Guanaxuato, Zacatecas, and Catorce, yield above one half of the precious metals which are exported. Since the commencement of the 18th century, at which period not more than five or six millions of gold and silver were produced, the quantity has been so much increased as to have been tripled in 50, and sextupled in 100 years, owing, no doubt, to the increase of population, and more immediately to the improvements in knowledge and natural industry. The property of these mines is possessed by certain individuals, who enjoy grants from the king, on condition of their paying about 18 per cent. on the minerals they extract. The miners, who enjoy freedom, health, and good encouragement, are said not to exceed 30,000; and notwithstanding all the advantages they enjoy, they are so extremely covetous and so addicted to theft, that, in a valuable mine, the pilferings of minerals detected within the course of one year, has been estimated at nearly L.8000.

Besides gold and silver, the mineral productions of Mexico are iron, lead, tin, copper, cinnabar, antimony, and zinc. Valuable quarries of marble, porphyry, and jasper are wrought; some green stones are found almost equal to emeralds; likewise cornelians, amethysts, cat's eyes, and turquoises are obtained, but diamonds are very rare. A remarkable glossy black stone called itztli is very abundant, which, being semi-transparent, is by the Indians employed for mirrors, and other purposes.

*Trade, Manufactures, &c.*—The want of navigable rivers and canals in a great measure retards the interior and coasting intercourse of New Spain. The interior trade is chiefly owing to the consumpt of provisions occasioned by the mines, as well as to the vast quantities of maize transported from one quarter to another as necessity demands. But as the city of Mexico constitutes the emporium of trade, thousands of mules laden with hides, tallow, bars of silver, wines, &c. arrive there every week, and in return for these commodities, take back woollen cloth, metals, and merchandise from the Philippines and from Europe. The foreign trade is that of the South sea and the Atlantic ocean, which latter has for ages been conducted at Vera Cruz. At the ports of Acapulco and San Blas on the western coast, a regular trade is carried on, chiefly by means of the Manilla galleon, a vessel of upwards of twelve hundred tons, which proceeds regularly with the west monsoon about the close of the month of June, with a rich cargo of goods, which though by law restricted to half a million of piasters, is often of three or four times that value. The contraband trade likewise, particularly in times of war, is with facility carried on to a great extent.

Besides the manufacture of woollen stuffs and calicoes, those of tobacco, hard soap, and powder are conducted on a very large scale. But by far the most important and valuable manufacture is that of plate; services of which are sometimes made in the capital to the value of 200,000 francs. The mint of Mexico, first established in 1535, may be viewed as a manufactory under the cognizance of government officers. In this establishment, which employs upwards of 350 workmen, the machines are so numerous that 30,000,000 of piasters can be conveniently coined in the course of one year. M. Humboldt has computed the value of coin issued from this mint since its commencement at the enormous rate of L.48,000,000 Sterling. The annual produce of the Mexican manufactures has been likewise estimated by the same ingenious author at L.1,470,000 Sterling and upwards.

*Revenue, &c.*—About the commencement of the 19th century, the revenue of Mexico was calculated at 20,000,000 of piasters, or L.4,200,000 Sterling. Of this immense sum, one half was consumed on the expense of the administration, and only two-thirds of the other half fell to the share of the mother country, as one-third of it was allowed to the other colonies. The military establishment, consisting of about 30,000 troops, including the provincial militia, was attended with the expense of almost one-fourth part of the total revenue.

*People.*—The characteristic features of the native Americans are, very small forehead covered with hair to the middle of the eye-brows, a broad countenance, little black eyes, a thin nose, small and bending towards the upper lip. The ears are large and far from the face, hair lank, coarse, and very black, feet small, body tall, well shaped, strong and active, and of a copper colour. Their features at first view seem regular and mild, but on narrow inspection they appear to discover something sullen, wild, and distrustful, and they are, in general, very much averse to toil and labour. Compared with Europeans, their appetite is extremely little, and they affirm that one Spaniard consumed more food in one day than was sufficient for ten Americans. The inhabitants of Mexico are made up of whites, Indians, negroes, and people of a mixed extraction. Of the whole population, the Indians or indigenous Americans form nearly about two-fifths; and among these no less than twenty distinct languages, as well as a great variety of dialects continue to be spoken, from which circumstance, it would appear, that these Indians must at one period have been composed of a number of different tribes. The whites, consisting of individuals born in Europe, or descended from Europeans in the Spanish colonies, are in the proportion of 16 to 100 of the other inhabitants. Not more than 6,000 negroes are supposed to be included in the population of Mexico, which is a considerably smaller number than is contained in any of the other European colonies under the torrid zone. Of the mixed casts, amounting to about 2,400,000, seven-eighths are mestizos, or sprung from whites and Indians. They are known by the whiteness and transparency of their skin, together with their thin beard, small feet and hands, and a peculiar obliquity of the eyes. They are more placid in their disposition than the mullatoes or descendants of whites and negroes.

At the time of the conquest the Mexicans were accounted very skilful in gardening, and not inferior to some of the most polished nations of Europe. They had not only their kitchen gardens and culinary herbs, but fruit trees of great variety, and their flowers and medicinal herbs were arranged with great taste and regularity. The royal gardens were peculiarly beautiful, exciting in the Spaniards the highest admiration, so much so that Cortes, in a letter to the Spanish monarch, informed him that the garden at Huaxtepec was the finest, most extensive, and delightful that had ever been seen. In sculpture and casting metals, the Mexicans had also arrived at considerable perfection, and in their statues they had learned to exhibit all the finest attitudes in which the human form could be placed. In works of gold and silver they greatly excelled, and the presents sent to the king of Spain by the conquerors filled the artizans of Europe with the utmost astonishment. In the art of painting they had made great proficiency, especially in the beautiful colours they made use of, which they obtained from flowers, wood, and the leaves of plants, as well as from animal substances. But the most curious of all their arts, and that in which they had made the greatest progress was Mosaic work, made of the feathers of birds of the finest plumage, and most brilliant and varied colours, for an account of which the reader is referred to the article *Mosaic*. In architecture, as might be seen both from their edifices and from their aqueducts, the Mexicans were also particularly skilful; nor were they by any means deficient in those manufactures that were most useful for the comforts of life. Although ignorant of the manufacture of glass, they had a great variety of earthen ware beautifully stained with the most brilliant colours, neither were they ignorant of the manufacture of paper, or the method of making cloth. In their dress they were very plain and simple, that of the men being composed of a large belt, the ends of which hung down before and behind, and that of the women being a square piece of cloth or mantle wrapped from the waist to the middle of the leg, with a small under vest or waistcoat without sleeves.

Their religious ceremonies, however, were accompanied with the most striking barbarities, and

20,000 victims are said to have perished annually in their sacrifices, some of whom were drowned, some starved to death, others burnt, but most of them having their breasts opened and their hearts pulled out. Even prisoners of the highest rank were put to death in conformity to this most shocking and disgraceful ceremony.

*Government.*—New Spain has been distributed into the three provinces of New Mexico, New California, and Old California, and into the intendancies of San Luis Potosi, Sonora, Durango or New Biscay, Guadalaxara, Merida, Mexico, Oaxaca, Vera Cruz, Valladolid, Puebla, Zacatecas, and Guanaxuato. Several of these intendancies are vastly more extensive than others, but are much less populous than some of the lesser divisions. According to the established colonial policy of Spain, the government of Mexico was entirely vested in the sovereign, who in all respects was represented by the viceroy. The court was magnificient, and similar to that of Madrid, and in his administration the viceroy was supported by officers and tribunals, over which he maintained the superiority. For the cognisance of civil and criminal causes, a tribunal or audience, with a proper number of judges, was established in every province; but with the decisions of such tribunal, the viceroy had no right to interfere. From these courts, however, decisions might, by appeal, be carried to the council of the Indies, when the subject under dispute was more in value than 6000 pesos. This latter court, which was instituted in 1511, and improved by Charles V. in 1524, exerted a decided authority over every department of government in the country, and the approbation of two-thirds of its members was indispensable to all laws connected with the colonies; likewise its meetings were held where the king was resident, he having been uniformly understood to be present in the council.

It is estimated, that about 13,000 or 14,000 individuals are connected with the ecclesiastical establishment of Mexico, which, like that of Spain, is not without its dignitaries. The salary of the archbishop is said to amount to 650,000 franks, and those of the bishops are proportionably handsome; but not more than 500 or 600 francs constitute the yearly income of some of the inferior clergymen. Unfortunately, the Catholic ritual in this country, as in Spain, is more adapted to amuse the fancy than to improve the heart; and, consequently, the poor Indians are merely familiar with the fantastic ceremonies of religion, which to them prove matter only of agreeable amusement.

*History.*—According to the supposition of M. Humboldt, New Spain was at an early period inhabited by a portion of the Hiongnoux, who emigrated from Tartary or China, and part of whom found their way through Asia and Europe, under the denomination of Huns. This, however, is merely a conjecture. The ancient history of the country being comprised in hieroglyphic paintings, (see LANGUAGE,) which are peculiarly enigmatical,—while the traditions regarding the history are extremely doubtful,—the true origin of the Mexicans can by no means be satisfactorily ascertained. From traditionary accounts, it appears that the Mexican empire had not been long in existence prior to the Spanish invasion; at the time of which Montezuma was the ninth person who had swayed the sceptre. But, from the great degree of civilization which the inhabitants are said to have attained when the empire was conquered by the Spaniards, it would seem that the Mexican nation had been very long in a most flourishing condition. Not a little exaggeration, however, is apparent in the flattering accounts which were given of the improved state of society and of the arts in Mexico at the time when the Spaniards first landed upon the shores of that devoted country.

The conquest of Mexico was in 1518 undertaken by Ferdinand Cortes, who, in the following year, sailed from Cuba, and effected a landing on the island of Cozumel, at the head of 508 soldiers, with a few field-pieces, 18 horsemen, and 109 mariners, pilots, and mechanics. On his march this celebrated adventurer met with little opposition from the natives along the coast, as the Spaniards at their first appearance spread universal consternation among them. Indeed, the animals on which they rode, together with the artificial thunder which issued from their arms, struck so great a panic into those quiet and inoffensive people, that the invaders were by them supposed to be something more than human; so that Cortes was the more emboldened in the prosecution of his daring enterprise, and therefore immediately resolved to force his way into the capital of the empire. In consequence of the spirited movements of Cortes, the Mexican monarch was induced to receive him at Cholula, which he did with much apparent satisfaction. This kindly reception was, however, followed by a most diabolical return; for, with the view of humbling Montezuma and his subjects, the defenceless multitude were erelong attacked without mercy. The streets consequently presented a horrid scene of blood and carnage, and even the temples, to which the priests and leading men had fled for shelter, were burnt to the ground. Cortes having thus, with unlooked for success, gained footing in the city, the hapless prince was so infatuated as to allow himself to be duped by his enemy even in the midst of his own guards and attendants; and being soon after obliged to appear in person, for the purpose of quelling an insurrection of his subjects against the Spaniards, he received a contusion on the head by a stone from an unknown hand, which occasioned his death in the course of a few days.

Subsequently to these operations, a succession of disasters befel the Spanish army in their retreat; but when about to yield themselves up to despair, they experienced a propitious change of fortune, by the splendid victory obtained over the Mexicans in the plains of Octumba. Cortes not long after received a considerable reinforcement of troops, and was thus encouraged to renew his efforts against the capital of Mexico, which, notwithstanding the determined opposition of the inhabitants, was ultimately subdued by means of war and famine, when Guatimozin, the unfortunate successor of Montezuma, was, together with his consort and children, taken prisoner. This prince heroically disappointed the sanguine conquerors respecting the immense wealth they had anticipated that they should obtain in the kingdom they had thus subjugated. Not even the most excruciating torture could draw from Guatimozin any confession respecting the royal treasures; and while he lay stretched on burning coals, he checked the sad impatience of his fellow sufferer, the high priest, with these remarkable words, *Am I now reposing on a bed of roses?*

By such unprecedented cruelties did the Spaniards at length effect a complete conquest of the extensive empire of Mexico, in which many thousands of the natives lost their lives, so that the glory consequent to their intrepid valour and successive victories was deeply sullied, and the barbarous deeds of the conquerors have left an indelible stigma upon the Spanish name. Every where throughout the Mexican dominions, the progress of the Spaniards was attended with blood. No less than sixty caziques or leaders, together with four hundred nobles, were at one time burnt to death in the country of Panuco. Even the Mexican monarch himself, whom Cortes had formerly rescued from the hands of his tormentors, was, under the aspersion of a pretended conspiracy, ignominiously put to death, along with two of the principal persons of the empire.

The quiet possession of their dominion in Mexico was enjoyed by the Spaniards without interruption from 1596 till 1601, after which period, disturbances ensued from time to time. In 1796 the Spanish authority was seriously threatened in many places, more especially in the province of Venezuela. But concurring circumstances tended soon after to establish the internal tranquillity of the country, which, however, has of late been much agitated. The result of revolutionary proceedings in 1814 was the framing of a new constitution, renouncing all allegiance to Ferdinand, and declaring Mexico a free republic. After considerable disturbance and bloodshed, Mexico was raised to the dignity of an empire in 1822; but the imperial throne was abdicated in the following year; and although, since that period, it has been agitated by various contending parties, it appears to be gradually rising to a state of independence.

MEXICO, the capital of New Spain, situated in the midst of an extensive and delightful valley, was rebuilt by Cortes subsequently to the conquest, and is now peculiarly remarkable for beauty and regularity, insomuch that it is surpassed by few towns even in Europe. Before the Spaniards had entered the country, the old city, founded on several islands, and surrounded with water, was in a flourishing condition, and accessible by means of three dikes or causeways about twenty feet broad, and extending above a league in different directions. In its present state, the city of Mexico has not only a magnificent but also a most substantial aspect, the houses being built of hewn stones, in a fine style of architecture, and the spacious streets laid out with striking taste and regularity; while the public edifices, monuments, and other embellishments are very attractive. Among the most interesting objects are the Cathedral, which is partly Gothic, and of modern date, the Hospital, the Treasury, contiguous to the viceroy's palace, the prisons, the University, the school of Mines, the academy of Fine Arts, the hotels or palaces, and the equestrian statue of Charles IV. in the Plaza Major. The number of public churches is 34, of convents 38. Besides the ancient causeways, which yet remain, others are formed across the marshy ground, which in some degree prevent the overflowing of the lake, while they serve the purpose of roads for carriages. This city is at once clean, well lighted, and duly supplied with fresh water. The water is brought from some distance, by means of two aqueducts; and vegetables and fruits are conveyed to the market in abundance, from the floating gardens in the adjacent lakes, by means of canals. According to the statements of M. Humboldt, the whole population of this city may be estimated at from 135,000 to 140,000, of which there are 5000 or 6000 military.

The city of Mexico has suffered almost as much from inundations as that of Lima from earthquakes. No less than 40,000 lives were lost in consequence of the overflowing of the lakes in the year 1629; and the canals having been interrupted, the country continued inundated from that period to 1634, when the frequent recurrence of earthquakes caused the waters to subside. After this a vast outlet was effected in 1789 through the mountains to the north-east, and which is perhaps the most amazing work of the kind ever known. It is called the Desague de Hue-huetoca, is above four leagues and a half in length, and from 278 to 360 feet broad at top, while the depth of the cut for a considerable space varies from 98 to 131, and from 147 to 196 feet. As the lake of Tezcuco still endangers the capital, another canal has been set on foot in order to drain it, the expense of which it is said will amount to L.125,000. Though this city has no communication with the sea by navigable rivers, it carries on great trade to Europe and Asia by Vera Cruz and Acapulco.

Mexico presents but few remains of antiquity, the ancient temples having been destroyed by the Spaniards at the time of the conquest. The environs of the city, especially when viewed in the morning from the towers of the cathedral, or the hill of Chapoltepec, is unusually grand and interesting. "The eye sweeps over a vast plain of carefully cultivated fields, which extends to the very feet of the collossal mountains covered with perpetual snow. The city appears as if washed by the waters of the lake Tezcuco, whose basin, surrounded with villages and hamlets, brings to mind the most beautiful lakes of the mountains of Switzerland. Large avenues of elms and poplars lead in every direction to the capital; and towards the south, the whole tract between San Angel Tacabaya and San Angusta de las Cuevas appears an immense garden of orange, peach, apple, cherry, and other European fruit-trees. This beautiful cultivation forms a singular contrast with the wild appearance of the naked mountains which inclose the valley among which the famous volcanoes of Puebla Popocatepetl and Iztaccicihuatl, are the most distinguished. The first of these forms an enormous cone, of which the crater, continually inflamed and throwing up smoke and ashes, opens in the midst of eternal snows."—Humboldt's *Essay on New Spain.*

MEXICO, New, an extensive territory of the Spanish dominions in North America, and so denominated in reference to its having been discovered later than Old Mexico, extends from 30° to 41° north latitude, along the Rio del Norte, and is bounded on the north by high mountains, on the east by Louisiana, and on the south by New Spain. Situated in the midst of the temperate zone, this country enjoys an agreeable and not unhealthful climate. It is, however, but partially inhabited, and only a small portion of it, comparatively speaking, is under cultivation; yet great encomiums have been bestowed on the fruitfulness of the soil. From the mountainous district on the north, which is supposed to be the most elevated land in this part of the continent, various great rivers flow in different directions, the chief of which are the Rio del Norte, Colorada, Arkausa, and Platte. This province contains mines of copper and tin; and the animals found in it are chiefly beeves, horses, sheep, buffaloes, and deer. It was first discovered in 1581, and is peopled principally by native Americans.

*St Fe*, the capital, is a fortified town, seated on a river which flows into the Rio del Norte. It is upwards of 500 miles north from Chihuahua, in 36° 12′ north latitude, and 104° 53′ west longitude; is the see of a bishop, and contains, exclusive of the garrison, 4500 inhabitants. The centre of the town is adorned with a spacious square, on the north side of which stand the palace of the governor and other public buildings. The houses have generally a humble aspect, being flat roofed, and only one story in height. Different manufactures are carried on in the neighbourhood of St Fe, the most important of which are cotton and woollen stuffs, leather, pottery, tobacco, and copper utensils.

MEZZOTINTO, a species of engraving. See Design.

MICHAEL ANGELO. See Buonarotti.

MICHAELIS, John David, an eminent theologian and biblical writer, was a native of Halle, in Germany, and born in 1717. He was instructed in classical literature by his father, and in 1739 obtained his degree of master of the philosophical faculty at the university of his native place. Having spent a short time in England and Holland, he returned to Halle, whence he removed to Gottingen, where, in 1750, he was appointed an ordinary professor in the philosophical faculty in that university. He enjoyed a constant intercourse with Haller, Gesner, Mosheim, and other eminent scholars. In 1761, he was chosen director of the Royal society of Gottingen, and afterwards became a member of various learned institutions. While engaged as a public teacher, the talents of Michaelis were most usefully employed in critical researches into the Old and New Testament. His great attainments in biblical philology peculiarly qualified him to illustrate the civil institutions of the Hebrews, in his valuable treatise on the Mosaic law. In 1786, he became privy counsellor of justice, and in 1788, he was chosen a fellow of the Royal society of London. The arduous duties of a professor were discharged by him for the long period of 45 years, and he died in 1791, at the age of 75. The *Gentleman's Magazine* for March 1792, contains a list of his various writings. His Dissertation on the Influence of Opinions on Language appeared in England in 1772, and his Introduction to the New Testament was translated into English, and published, with notes, by Dr Marsh, in 4 vols. 8vo. in 1802.

MICHAELMAS, an annual feast in honour of St Michael the archangel, observed by the church on the 29th of September, which is therefore called Michaelmas-day.

MICHIGAN LAKE, a great lake in the United States of America, situated between 42° and 46° north latitude; is of an oval form, and occupies an area of nearly 10,368,000 acres. It flows into lake Huron, is separated by a tongue of land from lake Superior, and abounds in excellent fish. The banks of this unfathomable lake are clothed with pine, cedar, and shrub oak.

MICKLE, William Julius, the translator of the Lusiad of Camoens, and the son of a Scotch clergyman, was born at Langholm, in Scotland, in 1734, and educated at the high school of Edinburgh. Having repaired to London in 1763, he obtained the countenance of Lord Lyttleton, and was, in 1765, employed as corrector of the Clarendon press at Oxford. In 1775, appeared his translation of the Lusiad, together with a dissertation and a life of Camoens. In consequence of the appointment of secretary to Governor Johnson in 1779, he became government agent for prizes at Lisbon, where he was chosen a member of the Royal academy, and treated with other marks of respect. On his return to England he wrote for the European Magazine, and settled at Whitby, in the vicinity of Oxford, at which place he died in 1789. His poems were published in 1794, in one volume, 4to.

MICROCOSM, *a little world*, from the Greek, is a term applied to man, as the epitome of what is wonderful in the universe.

MICROMETER, an astronomical machine, by means of which the diameters of the planets, and small distances in the heavens, are ascertained with considerable precision. See Optics.

MICROPHONES, in Accoustics, are instruments formed for magnifying small sounds, to render them more audible.

MICROSCOPE. See Optics.

MIDAS, in Heathen mythology, the son of Gordius, and a king of Phrygia, who, from entertaining Bacchus, had the power given him of turning every thing into gold, merely by his touch. But the inconvenience of every thing taken into his mouth undergoing this transformation, obliged him to pray to be freed from the peculiar effect of his own touch, when he was directed to bathe in the river Pactolus, which had thenceforward golden sands. His ears were lengthened into the ears of an ass, for giving verdict for Pan against Apollo in their trial of music. The avarice of Midas gave rise to this fable; for, not content with the great wealth arising from the disposal of the corn, wine, and cattle, which abounded in the country he reigned over, his subjects are said to have been employed by him in gathering gold from the river Pactolus. Likewise some have supposed that the long ears attributed to Midas, bear an allusion to the numerous spies or informers whom he appointed to ascertain every seditious word proceeding from his subjects.

MIDDLE REGION of the Atmosphere, is that space extending from the summits of low mountains to those of the highest, when the clouds are generally accumulated, and in which meteors are formed. Above and below this space, are the upper and the lower regions; and the former are supposed to be always calm and serene.

MIDDLEBURG one of the Friendly Islands in the south sea, discovered, in 1743, by Tasman, a Dutch navigator, is about 16 miles in length and 8 in breadth, and presents a finely diversified aspect. The houses are generally built in plantations; and yams, bananas, and bread-fruit, constitute the chief food of the inhabitants. See Friendly Islands.

MIDDLESEX, one of the central counties of England, bounded on the north by Hertfordshire, on the east by Essex, on the south by Kent and Surry, and on the west by Buckinghamshire; and extending about 23 miles in length, and 24 in breadth. It presents a comparatively flat surface, the principal eminences towards the metropolis being Hampstead, Muswell-hill, Highgate, and Harrow-hill. The climate of Middlesex is extremely mild and salubrious; the soil is various, but chiefly gravel, intermixed with loamy clay, and there is, perhaps, less rain in this than in most of the other counties of England. Considerable tracts of rich marshy land, in this county, remain in constant pasture, and many fields are clothed with almost perpetual verdure, the soil being enriched by the abundant manure of London.

Many of the arable farms are small, and the crops of wheat are, in general, inferior to those of Kent and Essex, both in quality and quantity. The meadows and pasture husbandry is sufficiently profitable to the farmers, who are peculiar adepts in their mode of making hay. Few cattle are bred here, though an immense number are kept for the supply of milk, which is forwarded from Hackney, Islington, and other dairy farms, to the metropolis. About 3000 acres of ground, extending from Kensington, through the parishes of Hammersmith, Brentworth, Isleworth, and Twickenham, are occupied in fruit gardens, and furnish constant employ to a great number of the inhabitants. In the nursery gardens, occupying nearly 2000 acres, in the vicinity of Chelsea, Kensington, Brompton, and Hackney, is to be found an abundant variety of the best vegetables, and most delicious fruits, together with an admirable display of the most beautiful, rare, and curious plants. Besides the Thames, Lea, Coln, and Brent, which bound this county on the south, east, and west, it is adorned with various smaller streams, one of which, the New River, has, at great expence, been conducted from the neighbourhood of Hertford, to supply the city of London with water.

Middlesex contains an area of 190,080 acres, and is divided into six hundreds, comprehending 98 parishes, besides those in London and Westminster. It is intersected by the great western road, the great northern road, and the road into Essex, Suffolk, and Norfolk, which are the three most frequented roads in Britain. The importance of this county arises chiefly from the cities of London and Westminster, which are situated in the south-east extremity of it.

Excepting in the metropolis and its immediate vicinity, few manufactures are carried on in this county to any great extent. The population, which in 1811 amounted to 953,276, had in 1821 increased to 1,144,531. The county sends eight members to Parliament. See London.

MIDDLETON, Conyers, an eminent scholar and divine, was born at Richmond in 1683, and died at his estate in Cambridge in 1750. A liberal education having been bestowed upon him by his father, he for some time officiated as curate at a village in the neighbourhood of Cambridge. While a fellow of Trinity college, he distinguished himself by maintaining a controversy respecting the mercenary conduct of Dr. Bentley, his master; and also another, respecting the dignity of the medical profession, with the whole body of physicians, which called forth a variety of pamphlets. In 1729, appeared his "Letter from Rome, shewing an exact conformity between popery and paganism." In the attack which he made on popish miracles, however, he gave rather a sceptical view of miracles in general, by which he brought upon himself the displeasure of the church, and his objections to Dr. Waterland's method of vindicating Scripture against Tindal's "Christianity as old as the Creation," proved equally offensive. His most valuable work, The History of the Life of M. Tullius Cicero, was published in 2 vols. 4to. in 1741, and his "Free Inquiry into the Miraculous Powers which are supposed to have subsisted in the Christian church from the earliest ages through several successive centuries," published in 1748, met likewise with great opposition. His works, with the exception of the Life of Cicero, appeared in 4 vols. 4to. after his death. Mr Middleton, while he has obviously displayed no ordinary learning and talents, seems to have betrayed a lamentable deficiency both of temper and prudence.

MIDIAN, in Sacred Geography, a country inhabited by the descendants of Abraham by Keturah, on the east of the Dead sea. Median the capital, is frequently noticed in the prophetic books of Scripture, and in the writings of Josephus and others.

MIDLOTHIAN. See Edinburghshire and Lothian.

MIDSHIPMAN, an inferior officer on board a man of war, whose duty is to assist in the management of the ship. A person must serve in this capacity, or in that of a mate, before he can attain the appointment of lieutenant. Twenty-four midshipmen are allotted to a first rate man of war, and to the inferior rates a proportionate number is appointed.

MIDSUMMER-DAY is celebrated by the church on the 24th of June, in commemoration of the birth of John the Baptist.

# MIDWIFERY.

Definition.

**Midwifery**, in the modern and extended use of the word, denotes that department of medical science which treats of the changes induced by pregnancy on the female system, the expulsion of the foetus, the peculiarities and diseases of the puerperal state, and the management of infants. The term owes its origin to two Saxon words, *mead* signifying reward, and *wife*, from the present it was usual for the woman to receive who assisted in child-bed. As females have usually been employed in this practice in every country, till about the middle of the 17th century, the appellation, both in ancient and modern languages, is always feminine, with the exception of the French *accoucheur*.

*History*.—From the time of Hippocrates many authors have treated of midwifery, but it does not appear that, for several centuries, the writings of any of them either much altered or improved the art. This, no doubt, was owing, in some measure, to the general darkness and proneness to imitation that characterised the age in which they lived; but much was also owing to the unfortunate prejudice that rendered the practice of it discreditable to medical practitioners. Without any hope of deriving profit from superior knowledge in this art, men of education had no inducement to acquire it, and those who wrote copied merely from such as had written before, without being able, from their own experience, either to confirm what was judicious, or correct what was absurd. Till towards the close of the sixteenth century, scarcely any one appears to have thought for himself upon this subject. It was then that Ambrose Paré, surgeon to Henry IV. of France, ventured, in some particulars, to impugn the reigning mode; and his writings, together with the establishment of a lying-in ward in the Hotel Dieu of Paris, seem to have given the first impulse to improvement. His pupil, Guillimeau, afterwards published the same instructions, with a summary of all that was known on this subject at the time; and this again was succeeded, in 1672, by the still more improved system of Mauriceau, an English translation of which was not long after presented to the public by Dr Chamberlain, who, at the same time, announced to the world his invention of the lever, an instrument by which, in difficult labours, the woman can frequently be delivered without destroying the child, as had formerly been the practice. It appears that the forceps, the instrument now in common use for that purpose, was also known to Chamberlain, and crept silently into favour about this period; but there is no written account of them till 1733, when they were described by Mr Butler in the *Edinburgh Medical Essays*. Since his day, however, their construction has been considerably improved by different practitioners, and particularly by Smellie, who also published a system of midwifery, which continued for many years the standard elementary work on the subject. More lately a regular succession of eminent names appear in the annals of midwifery. Levret, Hunter, Osborn, Denman, and numerous other distinguished individuals, have devoted their time to the cultivation of the science, and, by the talents and learning which many of them possessed, have succeeded in raising the practice of it to that pitch of respectability which it at present enjoys, and to which its importance to society so justly entitles it.

History.

### Of Pregnancy.

*Signs of Pregnancy*.—The first indication that leads a woman to suppose herself with child, is the suppression of the menses. This may be reckoned an invariable symptom of conception; for though instances have been recorded of women menstruating during pregnancy, none of them are well authenticated, and, if accurately observed, would have probably been found to be nothing more than cases of occasional discharge from the vagina in the beginning of gestation and slight hemorrhage from partial separation of the ovium in the more advanced stages. Soon after conception, the sympathy which exists between the uterus and the breasts begins to manifest itself. At first these glands seem to shrink, and become rather less than formerly; but about the third month they enlarge, and a dark brown circle is formed round the nipple. The stomach also is very frequently sensible of the important change, and nausea, particularly in the morning, vomiting, and heartburn, are the usual consequences. The face generally becomes pale, the features sharpen, and a livid line is observed to occupy the under part of the lower eye-lid, giving altogether a peculiar worn-out appearance to the countenance, very cognizable by an experienced eye. About the end of the second quarter, or twentieth week, the uterus becoming too large for the pelvis, rises above the brim, and the motion of the child being now perceptible by the mother, she is said to quicken. In some cases, a few drops of blood flow from the uterus at this period; and if the elevation be sudden, a fit of sickness, and sometimes an hysterical paroxysm is produced. The abdomen, by this time, is sensibly larger; and if the muscles be relaxed, the outlines of the uterus can be traced distinctly through its parietes. The pulse is generally a little quickened during the whole of pregnancy, and if blood be taken from a vein it exhibits a sizy appearance, somewhat resembling that of a person labouring under inflammation. The concurrence of the whole or the greater part of those symptoms are quite sufficient, in ordinary cases, to establish the existence of pregnancy; but, in particular circumstances, where the female is either likely to mistake her own state, or inclined to conceal it, our attention, in order to attain absolute certainty, must be directed to the uterus itself, the organ more immediately concerned in the process of gestation.

*Of the Gravid Uterus.*—Immediately after conception, the uterus becomes more vascular and begins to enlarge. Its cervix is stuffed with mucus, and ere long its inner surface is found lined with a new membrane, which from the circumstance of its falling off after delivery, is called the decidua. It is a shut sac, and of course closes both the mouth of the uterus and the fallopian orifices. Whilst these preparations are going on within the womb for the reception of the child, corresponding changes are taking place in one of the ovaria. It also becomes more vascular, and a small vesicle is observed on its surface, firmly clasped by the fringes of one of the fallopian tubes, through which, in the course of time, it is conveyed to the uterus. This is the ovum. When about to enter the uterus, it of necessity comes in contact with the decidua, which it pushes constantly before it in such a manner, that, by the time it has got possession of the cavity, it is completely surrounded by a reflexion of that membrane. The ovum itself is composed of two membranes, the outer one called the chorion and the inner one the amnion. At this early period of their existence, those membranes are not in contact as they afterwards come to be; but the amnion being much smaller than the other, a clear gelatinous fluid is interposed between them, which is gradually absorbed as pregnancy advances. The amnion is always attatched on one side to the chorion, and seems at first to contain nothing more than transparent liquid. The period at which the ovum enters the uterus has not been exactly ascertained, but is probably not sooner than three weeks after conception. About the sixth week it has attained the size of a chesnut, and the fœtus may now be observed about the size of an ant floating in the proper liquid of the amnion. So rapid is the progress of enlargement after this, that by the end of the third month, it is nearly three inches long, and before the end of the sixth it measures eight or nine, and weighs nearly a pound. At the full time, children vary in weight from six to eight pounds, and average in length about twenty inches.

From the umbilicus of the child proceed two arteries, which with their corresponding vein and membranous sheath form the umbilical cord. When the blood-vessels reach the uterus they divide and expand, and by uniting with the vessels of the decidua form the placenta, which thus consists of two portions, the one supplied by the mother and the other by the fœtus. The placenta is a flat circular body, generally about a span in diameter and nearly an inch thick, composed principally of blood-vessels with a small intermixture of cellular substance connecting them together. It is attached for the most part to the fundus of the uterus, and forms the medium of communication between the child and the mother. How that communication is effected, whether by effusion and absorption, or direct inosculation, is not exactly known. This only is certain, that a fluid injected into the vessels of the one system cannot be made to pass into those of the other.

The uterus which, in the unimpregnated state, is about three inches long and two broad at the fundus, nearly doubles its size in the first month of pregnancy, but without undergoing any remarkable change either as to form or position. During the later months, however, it gradually assumes an oviform shape, rises as already noticed from its original situation in the pelvis, till at length it reaches nearly to the pit of the stomach, its fundus inclining forward, and its cervix directed back towards the rectum. The usual period of gestation is nine months, counting from a fortnight after the last menstruation; but many women are delivered before that term, and some, though comparatively very few, go beyond it. Generally speaking, children do not live if born before the seventh month, though some have survived an earlier delivery. If they have no hair nor nails, and cannot suck and cry, there is no hope of them.

*Diseases of Pregnancy.*—Any one at all acquainted with the structure and physiology of the human body, will be ready to expect that pregnancy, which induces changes so considerable in the uterus, should sometimes at least excite disturbance in the system at large; and accordingly we find that almost every organ of the body is occasionally called to suffer from its effects. The brain, lungs, stomach, and bowels, the liver, the bladder, the circulating nervous and muscular systems, are each of them in their turns impeded or deranged in the performance of their functions. It would be impossible, in a work like this, to discuss at length the nature of each of those affections. We can only observe in general, that they arise ultimately either from the sympathy that subsists between the generative organs and the other parts of the body, or from the mechanical effects of the enlarged uterus. Their treatment must be conducted on the general principles already explained under MEDICINE, keeping always in view the tendency to plethora that exists during pregnancy. So universal is this tendency, that in almost all the diseases of pregnant women, however different or even opposite their symptoms, venesection is the principal remedy, and it often palliates or removes complaints at this time, in which its employment, had they occurred in another condition of the system, would have been useless or pernicious.

Besides the diseases already alluded to, there are some other disorders connected with pregnancy, which merit more particular notice, as being rather departures from the ordinary course of gestation than diseases excited by it. The chief of those are retroversion of the uterus, uterine hemorrhage, and abortion.

*Retroversion of the Uterus.*—The uterus is said to be retroverted when, losing its natural perpendicular position in the pelvis, its upper part falls back into the hollow of the sacrum, and its cervix is thrown forward on the neck of the bladder. This takes place only about the third or fourth month of pregnancy, or when the uterus has attained a corresponding size from some other cause, and is usually attributed to imprudent retention of urine, which, by distending the bladder, is supposed to drag the mouth of the uterus upward, and produce the accident. It is recognized by difficulty or inability of making water, bearing down pains, and tenesmus. As the principal danger, in such a case, arises from the bladder, our first attention must be directed to it, and its contents drawn off by the introduction of the catheter. Should the operation be found difficult, from the unnatural situation of the parts, it will often be facilitated by endeavouring to press back the vaginal tumour. When this has been effected, a gentle attempt may be made to rectify the position of the uterus, but no violence must be used. It is generally sufficient to ensure the safety of the bladder by the regular evacuation of its contents, and to allay irritation by anodyne injections, trusting to the efforts of nature for establishing a cure. By these means, the uterus will, in most cases, rise spontaneously in the course of a few days, and the patient do well.

*Abortion.*—When the child is expelled so early that it is incapable of living separate from the mother, abortion is said to have taken place, or the woman has miscarried. The principal phenomena attending it, are pain and hemorrhage, modified, in some degree, by the period of pregnancy at which the accident occurs. In the early part, that is, before or immediately after the fœtus has descended into the uterus, the symptoms are merely those of menorrhagia, accompanied with pain in the back, or hypogastric region: the minute vesicle escapes detection, and the discharge seems to consist of nothing more than coagula. In the second and third months, the pain is less constant, going off and returning alternately like the pains of labour, and the ovum descends entire; or if the membranes have burst, the child is expelled first, and the secundines follow after a longer or shorter interval. The pains in the later months are still more distinct, and resemble those of labour still more closely, only the hemorrhage is greater. In all cases, the functions of the stomach are apt to be disturbed; and where the flooding is great, syncope, more or less complete, is a regular attendant. The duration of the process varies much in different cases, but the termination is generally favourable—death is seldom, comparatively, an immediate consequence, but repeated miscarriages injure the constitution, and lay the foundation of future diseases.

The causes which more immediately induce abortion, are the death of the child, rupture of the membranes, and whatever is capable of influencing the circulation of the uterus, such as strong mental emotion, violent agitation of the body, and over-exertion.

When a woman is disposed to miscarry, the attention of the practitioner must be carefully directed to the particular source of danger. In plethoric habits, a light spare diet, and the habitual use of laxatives, must be prescribed;—the quantity of sleep should be abridged, and regular but very gentle exercise enjoined. When the danger seems to proceed from a weakened or irritable state of body, more nourishing diet must be allowed, and some simple tonic, such as bark or chalybeates, may be very properly advised. In neither of these cases ought the shower bath to be omitted;—in both it is useful, by invigorating the system, and enabling it to perform every function with more perfect accuracy. The patient should begin to use it before she has conceived, and continue it regularly till towards the end of gestation. When the miscarriage is apt to occur at a particular period, the greatest care must be taken to avoid the causes which usually excite it, and a small quantity of blood ought to be let when the time approaches. When the predisposition is very strong, confinement to a bed or sofa may be absolutely necessary during the greater part of pregnancy.

When the symptoms of abortion have actually come on, one of two objects must of necessity occupy the mind of the practitioner. He must either attempt to arrest its progress, or, if that shall be impossible, he must endeavour to divest it of danger, and carry his patient safely through. If the hemorrhage be trifling or moderate, especially if produced by an external cause, and the pain slight and only occasional, there is some probability that the child may be saved. The woman must immediately be put to bed, and if there be no excessive debility, blood must be immediately taken from the arm, and an opiate administered, to allay irritation. Cold air should be freely admitted into the apartment, absolute rest enjoined, and liquid food prohibited. By the speedy adoption of these measures, contraction of the uterus is sometimes prevented, re-union of the ovum takes place, and the patient goes on to the full time. When the uterine action has once commenced, expulsion must take place, and all that remains for the attendant is to accelerate the process, and prevent, as far as possible, the loss of blood. It is only from excessive hemorrhage that the patient runs any risk; and to obviate this, of course, is the object to be chiefly kept in view. If the habit be plethoric, and the pulse full and throbbing, venesection may be proper; but unless there exist some considerable degree of vascular excitement, no advantage can be expected from it. It will be better, in such cases, to trust to cold wet cloths applied to the back and pubis, or, if the hemorrhage be considerable, a soft cloth dipt in oil may be introduced to promote coagulation. Perhaps the best general rule in the treatment of abortion, is to command the discharge by stuffing, and, at the same time, to excite the contraction of the uterus, by stimulating saline injections thrown into the rectum. If there be any tendency to sinking from loss of blood, or painful sympathetic affections of the stomach or bowels, full doses of opium are necessary, but they are useless as sometimes given with the view of stopping the discharge. The patient must be kept constantly in bed, quiet and cool, and her drink acidulated with sulphuric acid, by way of refrigerant.

*Uterine Hemorrhage.*—It occasionally happens about the end of pregnancy, that discharges of blood take place from the uterus, so profuse as greatly to endanger both the mother and the child. These arise either from some accidental cause, producing a partial separation of the membranes from the womb, or more frequently from the placenta being placed over its mouth. The changes which take place in the shape of the cervix not being accompanied by any corresponding change in the placenta, some of the vessels which, when it is unfortunately placed there, pass between them, must, of course, be rup-

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tured; and as those changes occur chiefly in the latter months, it is then only that hemorrhage is occasioned from this cause.

The usual means of stopping hemorrhage must, in such cases, be employed; but where the flooding is considerable, the only measure that can insure the safety of the patient, is to procure the removal of the child by a speedy delivery. This, however, cannot be attempted in all circumstances. Whilst the os uteri is small and firm, the forcible introduction of the hand would, by producing inflammation, be almost certain death to the patient. It can be effected with propriety only after the os uteri has become soft and dilatable; and to prevent the loss of blood, stuffing must be used, as in abortion, till that take place. By using this precaution, irritation is avoided, and the coagulated blood, collecting in the upper part of the vagina, stimulates the uterus to contraction, by which the child is either expelled in the natural way, or the parts are so relaxed that the feet can be easily brought down by the hand.

*Extra-uterine Pregnancy.*—Another very important deviation from the ordinary course of nature, which it may be proper to notice here, is extra-uterine pregnancy. When the ovum does not descend as usual into the uterus, it is generally found to have been arrested in the fallopian tube, but sometimes also it is deposited among the bowels, or remains in the ovarium. The symptoms at first are rather ambiguous. The menses cease, the child quickens, and the breasts enlarge as in other cases, but the sympathetic effects of pregnancy are more severe, and the uterus does not enlarge so much in the latter months as when it contains the fœtus. Toward the end of the usual period, labour pains commence, and after continuing for an indefinite time, again subside. The motion of the child now ceases, and milk is secreted. Soon after this, symptoms of irritation generally supervene; inflammation takes place, and if the patient survive so long, the child is thrown off piece-meal, or entire, either through the abdominal parietes, or by the rectum, vagina, or bladder. In some rare instances, the fœtus has been converted into a substance resembling spermaceti, and a sac being formed around it, has remained in the abdomen, producing little or no inconvenience for many years.

## Of Parturition.

The second great branch of our subject is parturition, or that process of nature by which the child is expelled, after it is capable of living separate from the mother. It consists in the relaxation of the soft parts within the pelvis, and the contraction of the muscular fibres of the uterus by which that organ is shortened and thickened, and its contents forced through the vagina.

Mr Burns, in his excellent treatise on this subject, divides labours into seven classes.

Class I.—Natural labour is labour taking place at the end of the ninth month of pregnancy, the child presenting the central portion of the sagittal suture, and the forehead being directed at first toward the sacro-iliac symphysis; a due proportion existing between the size of the head and the capacity of the pelvis; the pains being regular and effective; the process not continuing beyond twenty-four hours; seldom above twelve, and very often not six; no morbid affection supervening capable of preventing delivery, or endangering the life of the mother.

Parturition.

This comprehends only one order.

Class II.—Premature labour is labour taking place before the usual period of utero-gestation, but not so early as necessarily to prevent the child from surviving.

This comprehends only one order.

Class III.—Preternatural labours, or those in which the position of the child is different from that which occurs in natural labour, or in which the uterus contains a plurality of children, or monsters.

This comprehends seven orders.

Order 1.—Presentation of the breech.
2. ——— of the inferior extremities.
3. ——— of the superior extremities.
4. ——— of the back, belly, or sides of the child.
5. Malposition of the head.
6. Presentation of the funis.
7. Plurality of children.

Class IV.—Tedious labour, or labour protracted beyond the usual duration; the delay not caused by malposition of the child, and the process capable of being finished without the use of extracting instruments.

This comprehends two orders.

Order 1.—Where the delay proceeds from some irregularity or imperfection of the muscular action.

Order 2.—Where it is dependant principally on some mechanical impediment.

Class V.—Laborious or instrumental labour, labour which cannot be completed without the use of extracting instruments, or altering the proportion betwixt the size of the child and the capacity of the pelvis.

This comprehends two orders.

Order 1.—The case admitting the use of such instruments as do not necessarily destroy life.

Order 2.—The obstacle to delivery being so great as to require that the life of the child should be sacrificed for the safety of the mother.

Class VI.—Impracticable labour, or labour in which the child, even when reduced in size, cannot pass through the pelvis.

This comprehends only one order.

Class VII.—Complicated labour, labour attended with some dangerous or troublesome accident or disease, connected, in particular instances, with the process of parturition.

This comprehends six orders.

Order 1. Labour complicated with uterine hemorrhage.
2. Labour complicated with hemorrhage from other organs.
3. ——— with syncope.
4. ——— with convulsions.
5. ——— with rupture of the uterus.
6. ——— with suppression of urine, or rupture of the bladder.

*Of natural labour.*—Before labour actually commences, there are certain precursory symptoms which announce its approach. The abdomen subsides a little, and the woman is sensible of the child lying lower, and feels herself lighter and more active than for some time before. Its actual presence is indicated by pain in the back, or pubis, or both, receding and returning alternately, in correspondence to the contraction of the uterus, by which alone the business is effected. It is generally divided by authors into three stages; the first comprehends the dilatation of the os uteri; the second the expulsion of the child; and the third the separation of the fœtal appendages. During the early part of the first stage the pains are slight and short, with intermissions generally of from ten to fifteen minutes, but gradually they become more severe, and recur at intervals of four or five. From first to last they are for the most part accompanied with considerable irritation in the rectum and bladder, producing a frequent inclination to make water or to go to stool. The os uteri, in the mean time, is gradually dilated, and in most cases the membranes are protruded through it during the pains distended with the liquor amnii. Nausea, vomiting, tremors, and cramps in the limbs, are occasionally present. In the course of eight, ten, or twelve hours, frequently much sooner, the mouth of the womb is completely dilated, and about this time the membranes, if they have not already burst, generally give way. When the second stage commences the pains become longer and more severe, and the head begins to descend. In entering the pelvis, it is placed diagonally across the brim, the forehead directed toward the sacro-iliac symphysis, and the vertex toward one of the acetabula, by which arrangement every possible facility is afforded to its transition, as in this way its longest diameter is made to pass through the widest part of the basin. By a continuance of the pains it slowly advances into the cavity of the pelvis turning gradually round at the same time, till the vertex is directed to the arch of the pubis and the face comes to occupy the hollow of the sacrum; so that, in passing through the outlet, its longest diameter is again in the direction of the widest part of the passage. By and bye the perineum is protruded in the form of a tumour, and the vertex reaches the orifice of the vagina. At this period of the process the child seems much less fixed than before, and in general recedes considerably during the intervals of pain, till at last, by a powerful effort of the uterus the head is expelled. After a short rest another pain succeeds, by which the shoulders are born and the second stage completed. In the course of fifteen or twenty minutes the uterine action again returns, and the placenta is separated and thrown off, accompanied in almost every instance by a discharge of blood. This spontaneous separation, however, is not an invariable occurrence, even in what are esteemed natural cases, as it frequently happens that, either from irregular or deficient contraction of the uterus, or owing to a firmer adhesion of the placenta, it is not expelled in the manner described, but requires for its removal the assistance of the practitioner.

In cases of this class the duty of the attendant is very easily performed. Having ascertained that the os uteri is stretched during the pains, or, in other words, that the woman is really in labour, and that the head presents favourably, little more is necessary during the first stage; the patient may lie, or sit, or walk about the apartment, as she feels inclined. But when the second stage is begun, and delivery is approaching, so much liberty cannot be allowed. She must then be confined to bed, and, if possible, prevailed upon to lie on her left side, that the practitioner may be able to assist her. A pillow should be placed betwixt her knees, and a firm towel, tied to the bed-post, given her to pull by. Most women also are desirous of having their feet supported and the hand of an assistant placed on the loins or sacrum during the pains. When the head has descended so far as to protrude the soft parts, the perineum must be carefully supported to prevent its laceration. This is of great importance, and requires the utmost attention, especially in first children, in which cases, by neglecting this precaution, the recto-vaginal septum is sometimes torn, and the comfort of the patient destroyed for life. If, when the head is born, the umbilical cord is found surrounding the neck of the infant, it must be cautiously pulled down to admit the free circulation of blood in it, and prevent its retarding the delivery of the body. When the uterus contracts upon the secundines in the usual way, nothing more is necessary than to favour their expulsion by pulling gently by the cord; but should no pain occur within an hour, the uterus must be excited to action. In most cases of this sort slight pressure with the hand on the surface of the placenta is quite sufficient to answer the purpose; but if not, no violence must be used. The extraction must be conducted with the greatest caution, the practitioner always bearing in mind, that his object is not so much to separate the placenta as to procure its separation by the contractions of the womb. When some parts of the cake adhere so firmly that their separation cannot be effected easily, what is loose must be brought away and the rest left to be discharged with the lochia. When the retention is owing to spasmodic, or what is called hour-glass contraction of the uterus from the middle fibres contracting strongly, while those above and below remain relaxed, it is sometimes rather difficult to accomplish its removal. A full dose of laudanum must be given to relax the spasm, and the fingers must be slowly and cautiously introduced one after the other, till the whole hand having passed, the placenta can be reached.

*Of premature labour.* — Although in some few cases of delivery before the usual term, the uterus is found to be fully developed, and the labour is early rather than premature, yet in the great majority of instances this is not the case. The early expulsion proceeds in general from some accidental cause disturbing the process of gestation before the proper changes have taken place in the os uteri and cervix. The delivery must be conducted very nearly in the manner already described, only the decidua being thicker now than at the full time, there is greater danger of hemorrhage in the early stages, and less exertion should be permitted on the part of the patient. When the labour is connected with a redundance of liquor amnii, it is an useful precaution, immediately after delivery, to introduce the hand, not for the purpose of extracting the placenta, but to have it in readiness lest irregular contraction of the uterus should take place, which, in such circumstances, it is peculiarly apt to do. Great care must be taken of the patient for some days after, as bad recoveries are more frequent in such cases than after natural labour.

*Of preternatural labour.*—In ordinary cases a round tumour is felt, in the beginning of labour, through the cervix uteri, formed by the head of the child resting above the os pubis; and it is the absence of this tumour that first suggests to the practitioner that all is not right. The circumstance of its being awanting, however, is no proof of an unfavourable presentation, as it sometimes happens either from the uterus lying high, or from malformation of the pelvis, that the hand cannot reach the head till the labour is considerably advanced. Nor, on the other hand, is the presence of the tumour proper evidence of a natural presentation, as it is generally felt in the three last orders of preternatural labours.

Ord. 1. *Breech presentation.*—The breech is distinguished by its size and softness, by the hollow between the thighs, and by the parts of generation. It may present in three different ways; that is, the belly of the child may be directed either to the back or to the belly, or to the side of the mother. The last of these is by much the least frequent position, the first the most favourable. To whichever of these varieties the case may belong, it must be left entirely to nature till the breech has passed the external parts. If it then be found that the belly of the child is directed towards the acetabulum or belly of the mother, the thighs must be firmly grasped and turned round, so that, in passing through the pelvis, the face may come to occupy the hollow of the sacrum.

Ord. 2.—*Presentation of the feet* is known by the want of the usual tumour, the smallness of the presenting part, and the little resistance it makes to the finger. When the membranes have burst, the heel and ancle are easily distinguished. This, like the breech case, must be left to itself till the thighs can be taken hold of; and then, if the position be unfavourable, it must be rectified in the same manner. The cord must be gently pulled down, lest the circulation be interrupted; and, unless the pains be very brisk, the delivery of the head should be hastened by introducing the finger into the mouth, and depressing the chin.

Ord. 3.—The only presentation with which the shoulder and arm can be confounded is that of the breech; and an accurate examination will always enable the practitioner to distinguish them. The peculiar characteristics of the breech are awanting, the shoulder is smaller and more prominent than the ischium, and the scapula and ribs can generally be felt.

In cases of this description, the greatest care is necessary. All exertion must be prohibited on the part of the patient, that the membranes, if possible, be preserved entire till the os uteri has become soft and dilatable. When that has taken place, the hand must be introduced, and having ruptured the membranes, must be carried forward into the uterus till it reach the feet. They are then to be grasped and brought down, with the toes directed to the back of the mother, and the delivery finished as in breech cases. The operation of turning is easy or otherwise, according to circumstances. It can, in general, be accomplished with sufficient facility if the hand be introduced before the membranes have burst; but if the water has been sometime evacuated it is always difficult, and, if the pains be strong and frequent, totally impracticable. All attempts will now prove futile; and if obstinately persisted in, can only increase the sufferings, and perhaps endanger the safety of the patient, by rupturing the uterus or producing inflammation. In order to lessen the uterine action, a large dose of opium ought to be administered; and when the pains in consequence have considerably abated, the operation may be attempted with a better prospect of success. If there be any fever present, or if the patient be strong or plethoric, a free bleeding may precede the opiate.

Ord. 4.—Cases belonging to this order are rarely met with. When they do occur the presentation keeps long high, and it is not till the labour is considerably advanced that the fingers can reach it. The rule of practice is precisely the same as when the shoulder presents.

Ord. 5.—The malposition may take place in four different ways. The forehead, instead of the vertex, may be turned to the acetabulum, or the side of the head may present, or the face, or the occiput.

Nature, in all those situations of the head, is able, for the most part, to accomplish the delivery, but the labour is tedious and painful. When the nature of the case is early discovered, it is proper, in all the varieties, to rupture the membranes and rectify the position; but where the liquor amnii has been sometime evacuated, the practice must vary according to circumstances. When the forehead is toward the acetabulum the head may frequently still be turned round by introducing the fingers behind the pubis and pressing firmly, during the pains, on the fore part of the parietal bone. When the face presents, and the position has not been rectified, all we can do is to support, with the fingers, the highest part of the presentation, and so favour the descent of the lower end.

Ord. 6.—The descent of the cord has no influence on the progress of the labour, but affects most materially the safety of the child, as the consequence of it is fatal if compression of the blood-vessels take place sufficient to prevent the transmission of the blood to and from the placenta.

When the membranes remain entire till the os uteri is dilated, the best practice, undoubtedly, is to turn the child; but if the labour be advanced before the circumstance is ascertained, all the practitioner can attempt is to keep the cord in those situations where there is least chance of compression. When the circulation is found to be actually suspended, the woman must be encouraged to bear down, or instruments must be used to expede the delivery.

Ord. 7.—The existence of a second child is never certainly known till the first has been expelled. If, after that, the hand be placed upon the belly, the uterus is found large, or if in examining per vaginam either some part of the child is felt or a second set of membranes.

When the presentation of the first child is natural, and the labour proceeds briskly, there is no necessity for interference; the breech or lower extremities of the second child will, in that case, generally present, and be delivered without assistance. When it so happens that the pains cease after the expulsion of the first child without accomplishing the delivery of the second, the same rule must be observed as has already been given respecting the placenta. If the contractions of the uterus do not recur within an hour, the hand must be introduced, and the child delivered by bringing down the feet. It ought always to be kept in mind, that the danger of hemorrhage is greater in twin cases than after single labours, and every means must be used to prevent it. The woman ought to be kept in perfect quietude, and the uterus excited to contract by applying the bandage pretty tightly, and gentle rubbing over the hypogastric region.

*Tedious labour.*—There are three general causes, on one of which the tediousness of labour must in every case depend. These are, 1st, The imperfection of the uterine action; 2d, The rigidity of the soft parts; and, 3d, Some disproportion existing between the head of the child and the pelvis of the mother. In the arrangement which we have adopted, the cases referable to the first of those causes are comprehended in the first order, those dependent on the two others are included in the second.

Ord. 1.—The most frequent deviation from the usual mode of action in the uterus consists in the feebleness of its contractions, indicated by slight pains recurring generally after longer intervals and lasting shorter than in natural labour. It proceeds sometimes from a lethargic habit of the patient, or from general debility or depressing passions of the mind, but more frequently from some cause connected with the uterus itself; such as premature rupture of the membranes, or over-distension of its fibres, by a redundance of liquor amnii, or plurality of children; or from labour having been brought on too early, as it were before the organ is prepared to expel its contents. When the labour is only a little protracted, all that is necessary, is to keep the patient cool and quiet, to support her strength by suitable nourishment, and cheer her with the prospect of a happy termination to her sufferings. If, however, the progress of the labour be very slow, and the woman is in danger of being worn out by the long continuance of useless pains, more active means must be had recourse to; of these the most important is venesection, which, however its action may be accounted for, has certainly the effect in many cases of quickening the pains, and shortening considerably the process of parturition. It is a remedy, however, by no means admissible in every case of defective contraction; for when this arises from debility or exhaustion, it is very obvious, that in place of removing it must greatly increase the evil. When the delay takes place in the first stage of labour, much good may be done by artificially dilating the os uteri. It is easily effected by pressing gently but steadily during the pains: and when done with proper caution and firmness, it is void of danger, and will be found to accelerate the labour, and lessen materially the sufferings of the patient. When the strength is nearly exhausted by the continuance of the pain, it is proper to procure rest by the exhibition of an opiate; but this ought seldom to be resorted to before the second night, and when it is, a full dose, not less than sixty drops, should be given.

The irregular action of the uterine fibres, which has been noticed above under the name of hour-glass contraction, occurs sometimes before as well as after delivery, and has always the effect of rendering the labour tedious. It is known by the pains doing no good, by their leaving a distressed sense of uneasiness in the back after they have gone off, and if the water has not been discharged by the membranes not relaxing during the intervals. It is useful in such cases to rupture the membranes, provided the os-uteri be soft and dilatable; and where the membranes have already burst, the head of the child should be raised during the pains to favour the complete evacuation of the waters. Blood-letting is of service if the os uteri be hard and tumid; but if that be not the case, or if the patient be weak and exhausted, an opiate injection ought to be administered. Spasmodic contraction and hemorrhage are apt to follow the expulsion of the child.

Ord. 2.—The first sort of impediment to be noticed is rigidity of the soft parts, a very common cause of slow delivery. It may occur in the os uteri or vagina, or both, and is most frequently met with in those who are advanced in life before bearing children. The most effectual method of promoting dilatation is blood-letting, which ought always to be employed where the habit of the patient admits its use; and when the pains have continued long, advantage should be taken of any partial remission to procure rest by the exhibition of an opiate. Where there exists a disproportion between the size of the head and the capacity of the pelvis, the labour of course must be more tedious than it otherwise would be. Many of the pains which should have been useful in propelling the child are necessarily expended in accommodating the cranium to the shape of the passage; but where the disproportion is minute, nature will still be able to accomplish the delivery. The duty of the practitioner consists in shortening the first stage when circumstances require it by dilating the os uteri; in attending to the regular evacuation of the bowels and bladder, and administering opiates when allowable to procure rest.

*Instrumental labour.*—We sometimes find that the contractions of the uterus are so feeble, or the resistance so great, that the efforts of nature are insufficient, and recourse must be had to the assistance of art. And even in many cases where spontaneous delivery might eventually take place, instruments are resorted to for the purpose of averting the danger which might accrue both to the mother and her offspring from long protracted and severe labour.

When the difficulty arises from contracted pelvis, there are various evils to be apprehended which the practitioner ought constantly to bear in mind. Sloughing of the soft parts may be produced by pressure; or inflammation may be excited within the abdomen; or if the pains be acute, the uterus may be ruptured, or the strength of the patient may be exhausted by the mere continuance of her sufferings. In the kind of cases at present under consideration, the forceps is the instrument almost universally employed, and is justly preferred to the lever, which, though easier applied, is much less certain in its operation. It is possible to apply the forceps whenever the os uteri is completely dilated, but it is only after the labour is farther advanced that it can be rendered useful in the hands of ordinary operators. When the head has descended so far that the ear can be felt behind the pubis, or the perineum begins to be protruded during the pains, it is in general an easy matter to give the necessary assistance; but when the presenting part lies much higher, the instrument must be made with longer handles, and extraordinary address is required to manage it. So difficult indeed is it to succeed in those circumstances, that only a few individuals habitually attempt it either in this or in any other country. It is often a point of some nicety in practice, how long we ought to trust to the resources of nature, and at what precise period it is neither rash to interfere nor safe to defer interfering: but where any doubt occurs, the practitioner should remember that it is better to be rather premature than too long in delivering. It is impossible, in a work like this, fully to discuss this part of the subject; but perhaps the following very general precepts may be useful to those who find it inconvenient to consult a more extended treatise. When the head is locked, that is, when it is so firmly impacted in the pelvis that it can neither be raised by the fingers nor depressed by the contractions of the womb, it is agreed on all hands that the woman ought to be delivered. It is to be observed, however, that the existence of such a state is not to be ascertained by one examination, for it sometimes happens, when the labour is slow, that the effect of one, or even of many pains, is not perceptible, while yet the head is gradually descending, and may at length be expelled without assistance: but if after the os uteri has been fully dilated, and the head has begun to enter the pelvis, the uterine action continues brisk for several hours without producing a decided advance, there is reason to believe that impaction has taken place, and that one or other of the evils above alluded to may result from delay. When the vagina during a tedious labour becomes dry and tumid, and painful, the attendant may suspect that inflammation is approaching, and use the forceps. If it be found, on introducing the catheter, that the kidneys have ceased to secrete urine, it is a proof that very serious derangement has occurred in the system, and a sufficient warrant for immediate delivery. When the pains after long continuance begin to flag, we may safely conclude that nature has done her utmost, and ought no longer to be confided in. There are other circumstances still in which the application of the forceps is required; but as these are afterwards noticed under the head of complicated labour, it is unnecessary to mention them more particularly here. The proper mode of using the instruments, is to introduce the blades successively on the opposite sides of the head, and having carefully locked them, and ascertained that the hold is firm, to extract cautiously during the pains, or at intervals, if the pains have ceased, pulling always in the axis of the part through which the head is passing.

Ord. 2.—If the pelvis be so deformed that a living child cannot pass, the head must be opened with the perforator, and the cerebral mass allowed to escape. When this has been effected, the bones of the cranium are afterwards compressed by the action of the uterus, and will frequently pass without more ado; but should they not, the crotchet must be applied, and the child extracted.

*Impracticable labour.*—In those unfortunate cases where the child cannot pass *per vias naturales* even after mutilation, it must either be removed by the caesarian section, or the woman must die undelivered. The operation which has obtained this name is simply an incision into the womb through the parietes of the abdomen. It is easily performed, but highly dangerous. With the exception of one case, it has always proved fatal in this country, generally by producing inflammation of the bowels, though sometimes the patients have sunk without its occurrence. Perhaps the last result might be less frequent if the operation were performed earlier than it commonly is.

*Of Complicated labour.*—Order 1.—When the flooding is profuse, the uterus must be emptied without delay. If the first stage be not completed, the os uteri must be cautiously dilated, and the child delivered; if the second have commenced, the forceps must be used.

Order 2.—Speedy delivery is highly desirable also when the hemorrhage occurs from any other organ; but the necessity for interfering is not so imperious as in the circumstances last noticed. Bloodletting, and the other means of checking the disease, may first be tried.

Order 3.—One fit of syncope is not a sufficient reason for delivering; but if the paroxysms be frequently repeated nothing else can secure the patient. Great care must be taken to prevent hemorrhage after the removal of the child.

Order 4.—The convulsion to which women in child-bed are liable is of the epileptic kind. The attack sometimes comes on suddenly, but more frequently it is preceded by symptoms indicating determination of blood to the head, such as intense headach, drowsiness, and slight delirium. The principal remedies are blood-letting and clysters. If the approach of the disease be observed, the attack may often be averted by a moderate bleeding; but if a paroxysm have actually taken place, copious depletion is absolutely necessary to prevent its recurrence. Should depletion not succeed, the uterus must be emptied by turning, or the forceps, according to circumstances.

Order 5.—Rupture of the uterus is one of the most formidable occurrences met with in practice. It is produced either by the intensity of the uterine action or by mismanagement in allowing the labour to continue too long when the pelvis is small, or by attempting to turn during a pain. The death of the patient generally follows a few hours after the accident.

Order 6.—When the catheter can be introduced, nothing more is necessary than to ensure the regular evacuation of the bladder by its occasional use; but where it cannot pass, if the labour be very tedious, the woman must be delivered.

*Of the treatment after delivery.*—After the placenta has been removed, it is usual to give a little wine and water, and make such alterations in the bed as are necessary for the patient's lying comfortably dry. A broad bandage is also applied round the body tight enough to give an agreeable feeling of support to the parietes of the abdomen; and if there be no particular tendency to fainting, nor excessive exhaustion, the body clothes are shifted. The patient ought to be kept very quiet and restricted to a light diet, which may consist chiefly of tea and dry toast, gruel and panada, for the two first days. A little chicken-broth may by and by be allowed her, and as the recovery proceeds she may gradually return to her usual diet. Some laxative medicine should in every case be ordered, so as to procure a motion within thirty-six or forty hours after delivery. When women have been very warm during labour, they often experience a severe fit of shivering immediately after. It is in general speedily checked by giving her the wine and water pretty hot, and applying warm cloths to the feet and stomach. It is common for women, especially those who have had several children, to be troubled for some days with intermitting pains in the back and belly, well known by the name of after-pains, arising from the uterus contracting to expel the clots of blood it contains, and return to its original size. A full dose of opium or camphor will frequently abate them, but they are seldom entirely removed till after the operation of the purgative.

*Inversion of the Uterus.*—When there is acute pain in the back and belly, strong bearing-down, weakness, and a feeble pulse, accompanied with a discharge of blood from the vagina, there is reason to suspect that the uterus is inverted: the reality of the fact is at once ascertained by examining the part. When early attention is paid to the case, the organ may sometimes be replaced by gentle pressure; but if that has either not been attempted or has not succeeded, the disease becomes chronic, and by repeated discharges completely destroys the health and comfort of the patient. In such a state of matters, extirpation has, of late years, been resorted to, and in several instances with the happiest result.

*Prolapsus of the Uterus.*—A more frequent, but happily less serious displacement of the uterus, is prolapsus, which consists in its leaving its natural situation in the pelvis and sinking down into the vagina. It is always attended with uneasy sensations in the loins, thighs, and lower part of the belly, and if the descent be considerable the discharge of urine is impeded, and the functions of the stomach and bowels are disturbed. It arises from general relaxation, or from imprudence in taking exercise too early after confinement, or from the uterus continuing large longer than usual. It is treated by rest in a recumbent posture, laxatives, tonics, a moderately tight bandage round the abdomen, and astringent injections into the vagina. In the event of these failing, a pessary is the next resource.

*Phlegmasia dolens.*—There is a distressing affection of the leg peculiar to women in child-bed, known by the name of phlegmasia dolens. It begins about ten or twelve days after delivery, with pain and stiffness in the groin, which gradually extend down the thigh, and the whole limb becomes hot and tumid. It is always accompanied with more or less fever. The treatment must consist at first in giving purgatives and diaphoretics internally, and applying leeches and saturnine poultices to the part affected. When the acute symptoms have been subdued, the next object is to restore the strength of the limb by a tight bandage and friction, and to re-establish the general health by light tonics, the cold bath, and country air.

*Suppression of the lochia.*—It sometimes happens that, in consequence of exposure to cold or other causes, the lochial discharge is suddenly stopped, and a painful swelling of the belly, sickness, and fever are found to ensue. From the intimate connection of this state with inflammation of the uterus, these symptoms require to be carefully watched. Purgatives, diaphoretics, and fomentations ought to be prescribed; and if the pain do not soon subside, blood-letting will be proper.—When, owing to premature exertion, the discharge, in place of being checked is rendered too profuse, causing pain in the back and general weakness, rest and tonics are the proper remedies. The cold bath should be ordered as soon as prudence will permit.

*Ephemera.*—That species of ephemeral fever called a weed, to which women in the puerperal state are so very liable, arises generally either from exposure to cold, or irregularities of diet, or mental agitation. It begins with a regular cold fit, attended with intense headach, pain in the back, and sometimes sickness. The cold after a while is succeeded by a hot fit, and by and bye a perspiration breaks out, which carries off the fever, but leaves the patient weak and languid. The business of the practitioner in this complaint is to carry the patient through all the stages of it as quickly as possible. During the continuance of the cold fit hot bottles should be applied to the feet and stomach, and warm drinks administered to restore the heat; and when the hot fit is established the external applications may be removed, but the warm drinks continued till the sweating stage begins, which ought to be maintained by the same means till the feverishness abate. The recurrence of the fit is to be obviated by avoiding as much as possible the exciting causes, regulating the action of the bowels, and strengthening the system by the use of tonics.

*Milk fever.*—When the milk begins to be secreted the breasts occasionally become affected with a painful hardness, accompanied with fever, which, like the ephemera, consists of a cold, hot, and sweating stage. It is, in fact, merely a weed, arising from this particular cause; and its treatment is to be conducted on the same principle. The breasts ought

Parturition.

to be emptied of their milk to relieve the uneasy distention occasioned by superabundant secretion.

*Inflammation of the Mamma.*—Of all the diseases attending the puerperal state, inflammation of the mamma is the most common. It is generally ushered in by some degree of fever, and is at once recognised by a hard and painful swelling taking place in the breast; the hardness sometimes circumscribed and superficial, at other times so extensive as to occupy the whole of the gland. It most frequently owes its origin to cold, but sometimes also to the pain and tension occasioned by retention of the milk. In the great majority of instances, it ends in suppuration. So soon as the nature of the case is observed, fomentations and poultices ought to be applied. Attempts to procure resolution by leeches and cold applications seldom succeed, except in the very slightest cases; and in them the same result is more conveniently obtained by the emollient poultice. If the breast feel uneasy from the accumulation of milk, it may be gently drawn by a nurse; but should the suction give pain, it will be better omitted. When the suppuration is matured, and the abscess offers to point, the patient may be saved from some distress by an artificial opening, the poultice being continued till the hardness is completely gone. In the inflammatory stage of the disease the antiphlogistic regimen must, of course, be observed; but after the abscess has burst, if the discharge be profuse, it may be necessary to support the strength by a generous diet and the use of tonics. In this way the parts generally heal without much trouble; but new collections of matter sometimes continue to form in different parts of the breast, producing numerous and troublesome sinuses, which require to be freely exposed with a knife before a cure can be obtained.

*Puerperal Fever*—The leading symptoms of puerperal fever are pain and fulness of the abdomen, oppression about the precordia, nausea or vomiting, pain in the head, and some degree of confusion, or even slight delirium during the night. The pulse is always quick, but the temperature of the skin is not much raised, nor is the thirst considerable. At the onset of the disease the tongue is pale, but soon becomes brown, and the whole mouth is covered with apthae; the bowels are loose, and the stools dark and fœtid. The lochial discharge is changed in appearance, always diminished, and sometimes entirely suppressed. In bad cases the face assumes a pale inanimate hue, the features express great anxiety, and the patient lies chiefly on her back, listless and indifferent as to what is passing around her; respiration is difficult; the belly swells to a great size, and though always tender, is little complained of except on turning, or when pressure is made on it. The attack commences on the second or third day after delivery, and, like other febrile complaints, is generally preceded by a fit of rigour. There is the most perfect evidence that the disease is infectious, and it also appears to be sometimes epidemic.

No subject in medicine has of late given rise to a greater conflict of opinions than the mode of treating this complaint. While some practitioners extol early and copious depletion as the only chance of saving the patient, others trust chiefly to purgatives, fomentations, and cordials, and denounce venesection as certain destruction. The truth is, that no proper treatment has yet been discovered, for neither plan is generally successful, though each of them can furnish instances of recovery. The buffy appearance of the blood taken from the arm, and the traces of vascular action exhibited by the peritoneum after death, are circumstances which would induce us to rank this fever amongst inflammatory diseases, but whether the inflammation be of a kind that is under the influence of bleeding and the other antiphlogistic remedies, must be left to farther experience to determine.

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Migration.

MIGRATION implies a change of residence, or a removal from one place to another. The term is used more especially to denote the regular flights to distant countries performed by birds of passage. The principle of migration appears to be indispensable in the economy of nature; and it is consequently not confined to the feathered tribes alone. Mankind have in all ages emigrated in colonies, with the view of effecting establishments in particular quarters, and to this circumstance may be attributed the diffusion of our race throughout the habitable globe. (See COLONY.) Partial migrations are made by quadrupeds, with the view of accommodating themselves as to temperature, food, shelter, and the like. Thus the stag, rein-deer, and roebuck, quitting the mountains during winter, descend to the plains and copses, and on the return of the summer season again instinctively return to their elevated and favourite haunts, where they avoid being harassed by insects. The mole resorts to hillocks and flat lands in summer, but repairs to elevated grounds in winter to avoid the danger of flooding. Oxen, in the more northern parts of Europe, repair to the shores of the sea during the inclemency of the cold season, and there feed on marine plants and the bones of fishes. Rats likewise migrate in immense numbers from time to time, in Norway, Lapland, and other countries; and in their peregrinations they usually persist in keeping a direct course, from which, indeed, they are to be deterred only by uncontrollable difficulties.—They even exert their prowess in crossing considerable lakes by swimming, and when they meet a boat or other vessel in their way, they climb up one side and descend by the other. Bell, in his journey to Pekin, states, that as he and his fellow travellers were proceeding along the river Tongusta in the beginning of March, they one day chanced to meet a prodigious number of hares, all as white as the snow upon which they walked. "I speak," says he, "within compass, when I say, there were above five or six hundred of them. They were coming down the river very deliberately, on a small path of their own making, close to the beaten road. As soon as they saw us, all of them ran into the woods, without seeming much frightened. I am informed that those hares travel to the south in much greater flocks than this every spring, and return in autumn when the rivers are frozen and the snow falls."

MILAN, or Milanese, a duchy of Italy, bounded on the north by Switzerland, on the east by Bergamasco, Mantua, and Parma, on the south by Genoa and Parma, and on the west by Piedmont; is 150 miles in length and 78 in breadth, and is productive of corn, wine, fruit, rice, and olives. It is watered by means of canals, as well as by the rivers Sesia, Tesin, Addà, Oglio, and Po, and is celebrated for beautiful lakes, of which the Maggiore, Como, and Lugano, are the principal. The French subdued Milan in 1796; and although it was wrested from them in 1799 by the allies, they again became masters of it in 1800, but restored it to the Austrians in 1814.

MILAN, formerly the capital of the duchy of that name, but now the capital of Lombardy as formed by the French, is a spacious city, defended by a wall and ramparts, and having a remarkably strong citadel. Besides a variety of churches and stately structures, it contains a very splendid cathedral, constructed of white marble, and in the Gothic style of architecture. This great and magnificent pile is divided into five naves by means of fifty-two immense marble columns, and is lighted through the medium of five cupolas. In fretwork, carving, and statues, it is surpassed by none. Its principal tower, crowned with a balcony, and 400 feet in height, is ascended by 468 steps. Many fine statues are contained in the church, as well as treasures of great value, and a shrine of rock crystal, wherein is deposited the body of St Charles Boromeo, dressed in pontificals. The Ambrosian college is gratuitously attended by sixteen professors, and has attached to it an academy of painting, a museum, and a library consisting of 45,000 volumes and 15,000 manuscripts. The other literary institutions are the palace of the Sciences, the college of the Nobles, the Helvetian college, and the Mathematical academy. Among the charitable establishments are the Lazaretto and the Great hospital as it is called, which has a revenue of 100,000 rix-dollars, and is devoted to the reception of sick persons, foundlings, and lunatics. In the outskirts of this city is situated the Arena, a place of amusement qualified to accommodate 30,000 individuals, and wherein nautical and other grand exhibitions are displayed.

Milan is said to be inferior to Turin in point of regularity and beauty. Many of the streets, indeed, are crooked, and paper-windows are rather general. The suburbs, however, are beautified with gardens, orchards, and gentlemen's seats, while the city itself is in a very flourishing condition with manufactures and commerce, the latter being facilitated by means of two canals, one of which extends to the Tessino and the other to the Adda. The trade in grain, cattle, and cheese, is very considerable, and the principal manufactures are those of silk, wool, goats' hair, glass, and porcelain, together with gold and silver lace, embroideries, and curious works in steel, crystal and various gems. The population is estimated at 150,000. Milan is situated in a plain between the rivers Adda and Tessino; together with the gardens it is ten miles in circuit, and it is an archbishop's see. The council consists of a president and sixty doctors of law, all of whom are nobles, and independent of the governor-general.

This city has experienced many vicissitudes, and has been alternately possessed by the French, Spaniards, and Germans. Napoleon Bonaparte was here crowned king of Italy in 1805.

MILBORNE-PORT, a borough town of Somersetshire, seated on a branch of the river Parret, is a place of great antiquity, and contains a population of about 1000. It sends two members to Parliament, but is not a market town, though, from Doomsday, it appears once to have had a market and 56 burgesses. Woollen and linen cloth are the chief manufactures.

MILDEW. See Agriculture and Gardening.

MILE, a measure of length or distance. See Measure.

MILFORD-HAVEN, a maritime town of Pembrokeshire in South Wales, is agreeably situated on a gentle eminence, and consists of three principal streets. The church is a fine edifice, and in the chancel of it is a vase of red porphyry, brought by the learned Dr Pococke from Egypt. Milford has one of the best harbours in the world, having sixteen deep and safe creeks, five bays, and thirteen roads. This place is the regular port for the mails from England to Waterford. Besides the whale fishery, which is carried on here by Quakers to a great extent, there is likewise some trade in wood and stores. Many improvements have been made on the haven, and a dock-yard has likewise been formed.

MILITARY STATE applies to the soldiery who are appointed for the safeguard and defence of the kingdom. For the due preservation of the balance of power, it is judged prudent by the legislature, even in times of peace, to maintain a standing body of troops under the authority of the crown.

MILITIA, a body of soldiers, or those who make a profession of arms; but, in a more restricted sense, the term applies to the trained bands of a town or county, who arm themselves for defence upon a short notice. Lord-lieutenants in each county are appointed by the king for the command of this local body of troops. Historians agree in opinion that King Alfred was the first who settled a national militia in this kingdom. The order in which the militia now stands is chiefly modelled from the statutes enacted subsequently to the restoration of Charles II. though a number of new regulations have been framed respecting proper discipline. The militia form the constitutional security for the peace and defence of the realm.

MILK. See Agriculture and Chemistry. Skimmed milk is of essential use in the wine trade, as it precipitates any colour derived from the cask, and renders the wine perfectly pure. It is much used abroad on account of its efficacy in fining down white wines, arracks, and small spirits.

MILKY-WAY, or Galaxy. See Astronomy.

MILL, an engine for grinding, pounding, or bruizing various substances—made to turn with wheels, and forced to its movement by the application of water, steam, wind, or animal power. The term is applied to all kinds of machinery where large wheels are made use of. Mills are of various kinds, and are distinguished either according to the powers by which they are moved, or the purposes to which they are applied. Such are water or wind mills, corn, flower, or bark mills, powder, fulling, or boring mills, and many others used for various purposes in the arts of civilized life. To enter into a minute description of these different kinds of mills would be altogether superfluous in this place, as the principles upon which they are constructed are sufficiently detailed under the article MECHANICS.

The simplest method for reducing corn into flower, and preparing it for bread, is pounding; and this, so far as we can learn, was the only one practised by the Romans, even so late as the reign of Vespasian. Among the ancient Gauls and Britons, corn was ground by hand-mills, consisting of two stones, like those used in water-mills, and the upper one was moved by a piece of wood fixed into the stone. In some remote parts of Scotland these are still to be seen, and are called *querns*, but have now given place to the more useful and efficient invention of water mills. Italy claim the merits of this discovery, and to the Romans we are supposed to be indebted for the introduction of this machinery into Britain, along with many other refinements in the arts of life. The term itself naturally leads to this conclusion,—the Welsh and Cornish *melin*, the Armorican *mull* and *meill*, and the Irish *muilind* and *muilean*, being all evidently derived from the *mola* and *molendinum* of the Romans. Whitaker, in his History of Manchester, supposes that one of these mills was probably erected at every station which they occupied in the kingdom, and that, in particular, one of these was constructed at Manchester, and was used equally for the convenience of the town and the garrison.

MILL-STONE, the stone by which corn and other substances are reduced or broken. Mill-stones, in early ages, were very different from those now in use. Several of these were found in England only twenty inches in breadth, supposed to have been used by the Romans in ancient times. Among the Jews and Egyptians, slaves and captives were employed in turning mills, and, in performing this work, they pushed the mill-stones before them with all their force. To this labour was Sampson condemned by his enemies the Philistines.

Stones of this kind are various, according to the different uses to which they are applied. Those employed for grinding wheat are termed *burrs*, and, till lately, were imported into this country from France, but are now found equally good both in Scotland and Wales. An inexhaustible quarry, situated near Conway, affords stones proper for this use, and which are tumbled down the side of a steep mountain, within a few hundred paces of the harbour where they are shipped. Stones of a similar kind were also discovered near Stirling in Scotland, by James Brownhill, miller, during the late war, when they could not easily be obtained from France. On examination, they were found proper for grinding wheat, and, after a complete trial by Mr Bell at the Alloa mills, they were considered not, in any degree, inferior to the burr mill-stones of France, and are now at work in many parts of Britain.

MILLAR, JOHN, professor of law in the university of Glasgow, was a native of Lanarkshire, in Scotland, and born in 1735 in the parish of Shotts, of which his father was minister. He received the early part of his education at the grammar-school of Hamilton, and, being intended for the church, was sent, in 1746, to the college of Glasgow. During his academical course, he became acquainted with several distinguished characters, among whom were Dr Adam Smith and the celebrated Mr Watt; and about the time of its completion, he was invited to reside as a private tutor in the family of Lord Kaimes. While in this agreeable situation, he became intimate with Mr Hume the historian, and undertook the tuition of his nephew, lately professor of Scotch law, but now one of the barons of Exchequer in Scotland. When called to the bar in 1760, Mr Millar exhibited no ordinary talents; and in the following year he succeeded to the professorship of law at Glasgow. By his eminent talents and attainments, and his ardour in the discharge of his professional duties, he soon attracted general notice; and while he drew around him a numerous and respectable concourse of students, he not only raised his own reputation, but likewise promoted the celebrity of the university. He delivered lectures on the Roman law—on the general principles of jurisprudence—on government—on Scotch law,—to which was latterly added, lectures on the law of England; and he usually spoke from notes containing merely his arrangement, his principal topics, and some of his leading facts and illustrations. But while he thus trusted very much to extemporaneous eloquence, so accurate and captivating was his manner of communicating instruction, that he failed not to inspire his pupils with an ardent thirst for learning.

Notwithstanding the labour and attention necessary for the exercise of his important public functions, he found leisure to take an active part in promoting the views of a respectable literary society in the university, of which he continued a most useful and steady member for the long period of forty years; and he likewise occasionally gratified his taste for agricultural pursuits at Milheugh, a property to which he succeeded in 1785 by the death of his uncle. His work on the Origin of the Distinction of Ranks, appeared in 1771; and in 1778 was published his Historical View of the English Government, from the Settlement of the Saxons in Britain to the Accession of the House of Stewart. Besides these works, Mr Millar published some anonymous political pamphlets, and contributed a few essays to the *Analytical Review*. He visited London first in 1774, and afterwards in 1792, and had the pleasure of being introduced to Mr Fox and other eminent characters, as well as of enjoying the society of his former pupils, Lord Lauderdale and Mr Adam, now Lord Chief Commissioner of the Jury Court in Scotland; and he likewise spent much of his time in the family of his friend, Dr Moore, the author of Zeleuco and Edward. As his political principles were decidedly in favour of the Whig party, the spirit of reform kindled in this country, by the powerful example of revolutionary France, was, at first, hailed by him as an event highly conducive to the cause of liberty, and he, therefore, became a zealous member of the association of the friends of the people. In 1795, his domestic happiness was clouded by the loss of his wife and other bereavements. About four years afterwards, he was himself subjected to a dangerous disorder, and he died in 1801, at the age of 66 years. In his habits and mode of life, Mr Millar was extremely temperate and methodical. He possessed a richly cultivated understanding, and was remarkable for vivacity. In literature and the *belles lettres*, in English, French, and Italian poetry, and especially in the classics, he was deeply conversant. His writings, however, though sufficiently clear and accurate, are less popular than they would have been had they participated somewhat of those elegant attractions which gave energy to all his exhibitions as a public lecturer. See Craig's Account of the Life of Professor Millar, prefixed to the edition of his treatise *On the Origin of the Distinction of Ranks*, published in 1806.

MILLENARIANS, or CHILIASTS, the denomination of a religious sect who flourished in the primitive ages of the church, and who believed that the saints were at some future period to reign with Christ on earth for 1000 years.

MILLENNIUM, from *mille anni*, the thousand years during which it has been supposed Jesus Christ will reign with the faithful on earth, when they shall enjoy every temporal blessing, and which will be immediately followed by the day of judgment. Although in the primitive ages of the church many individuals believed in the doctrine of the Millennium, yet the most eminent divines never encouraged this opinion, nor was it ever adopted by the church as an article of the established creed. The millenarians held, 1st, That after the coming of Antichrist, and the destruction of all nations which shall follow, there shall be a first resurrection of the just alone. 2. That all who shall be found upon earth, both good and bad, shall continue alive; the good to obey the just, who are risen as their princes, the bad to be conquered by the just, and be subject to them. 3. That Jesus Christ shall then descend from heaven in his glory; that the city of Jerusalem shall be rebuilt, enlarged, and embellished, and its gates shall stand open night and day. 4. That the saints during this period shall enjoy every earthly felicity. To this New Jerusalem the Millenarians applied what is said in the Apocalypse, chap. xxi. and to the temple all that is written in Ezekiel, chap. xxxvi. Here they imagined Jesus Christ will fix the seat of this glorious empire, and will reign for 1000 years with the saints, the patriarchs, and prophets, who shall enjoy all the delights of perfect and uninterrupted happiness. These passages in scripture respecting the reign of our Saviour on earth for 1000 years, were by some understood in a literal, and by others in a metaphorical sense; and it has been contended that these passages relate not to a resurrection of martyrs, and other just men, to reign in a visible kingdom with Christ Jesus for 1000 years, but to that state of the church which, before the general judgment, will be so pure, that when compared with the former ages of the world, it may be denominated a resurrection from the dead. In the opinion of the most learned divines, therefore, the millennium is that glorious state of the church in which it shall flourish in peace and righteousness for 1000 years, when the Jews shall be converted to the Christian faith, and with the Gentiles be united into one church, although not under the personal government of Christ Jesus. Further information may be found on this subject in the works of Dr Whitby, Dr Gill, Mr Mede, and Bishop Newton.

MILLING, or FULLING. See CLOTH MANUFACTURE.

MILLREE, a Portuguese gold coin, worth from four to six shillings English, according to the rate of exchange.

MILO, the ancient Milos in the Archipelago, an island upwards of fifty miles in circumference. When the Romans conquered the isles of the Archipelago, Milos lost its liberty, and in the partition of the empire it was at last conquered by Soliman II. It is fertile in corn and fruits. The island contains two towns, Milo the capital, and Castro, or Sifours. Compared to what it was at the commencement of the last century, it is now almost depopulated, and near to Castro are to be found many of the remains of its ancient splendour, fragments of columns of Parian marble, antique catacombs, with funeral inscriptions, subterraneous galleries, medals, vases, and other remains of a magnificent city. No trade is now carried on in this place, and it is chiefly inhabited by pilots and poor families from the Morea, who have taken refuge here on account of the fertility of the soil. Milo abounds in partridges, which the peasants, concealing themselves behind a portable screen, collect together by a call, and having placed the muzzle of their piece in a small aperture in the centre, they fire among them, and frequently kill many at a shot.

MILTIADES, an Athenian general, son of Cypselus, who obtained a victory in a chariot race at the Olympic games. In obedience to the oracle of Delphi, the Thracian Dolonci invested him with sovereign power, and he left his kingdom to Stesagoras, the son of Cimon, his uterine brother. Cornelius Nepos, who wrote a life of him, confounds his actions with those of the son of Cimon; but Herodotus, who was born about six years after the battle of Marathon, must have been better informed of the heroic actions of men who flourished in his own age than that historian, who lived nearly 500 years after that period.—See GREECE.

MILTON, JOHN, the most eminent of the English poets, and, in Dryden's estimation, the most illustrious of all poets ancient or modern,—was descended of an ancient and respectable family in Oxfordshire, and was born in London in 1608. The extraordinary indications of genius manifested by him, even in his juvenile years, rendered him the pride and solace of his father, who proposed to educate him for the church, and accordingly committed him to the care of an able private tutor. Even at the early age of 12 years, he was so ardent in the pursuit of literature, that he was accustomed to pore over his books till midnight. At the age of 15, he paraphrased some of the Psalms into English verse; and at 17 he composed an ode on the death of a fair infant, a production which, in point of beauty and excellence, seemed far beyond his years. About this time he was entered a pensioner of Christ's college, Cambridge, and after having obtained his degree of master of arts he returned to his father's residence in Buckinghamshire in 1632, where, during the five succeeding years, he assiduously devoted himself to study, and composed his *Comus, Lycidas, Arcades, L'Allegro, and Il Penseroso.*

With the concurrence of his father, and the judicious advice of Sir Henry Wotton, he, in 1638, set out from England on a visit to the classic regions of Italy. Having arrived at Paris, where he was introduced to the celebrated Grotius, he thence proceeded to Nice, embarked for Genoa, and went through Leghorn and Pisa to Florence. At the latter place, his inimitable talents, and intimate acquaintance with Italian literature, gained him ready admittance to the Florentine academies, and procured him the most flattering civilities and respect of men eminent for wit and learning. He had likewise an opportunity of conversing with the unfortunate Galileo, then confined by the barbarous Inquisition for his enlightened views in philosophy. Repairing to Rome, he had there an equally gratifying reception; and continuing his route to Naples, he had the happiness of a propitious introduction to Manso, the patron and biographer of Tasso; but his unseasonable freedom of remark on religious topics, precluded so very intimate an intercourse with that nobleman as might otherwise have been enjoyed. It would appear that Milton now first felt that stimulating impulse afterwards expressed by him, of preparing some grand poetical work, "which," to use his own words, "he should leave so written to after times, that they should not willingly let it die."

The breaking out of the civil war in England, induced him to make a hasty return home without having obtained a survey of Greece and Sicily, as had been designed at the commencement of his travels. On his arrival in the metropolis, Milton procured lodgings in St Bride's Church-yard, and employed himself for a time in educating his nephews, John and Edward Phillips, together with a few other young gentlemen. The plan of teaching followed by him on this occasion is characterized by Dr Symmons, as *respecting things rather than words*; but though disapproved of by the Doctor, it seems to have been well adapted to inspire the juvenile mind with a predilection for science, if the experience of no less a scholar than Sir William Jones may be adduced as confirmation on the subject.

Having long cherished an ardent desire for civil liberty, he rejoiced to perceive the authority of the bishops of the Episcopal clergy on the decline; and while the tide of popular opinion was strongly opposed to them, he eagerly hoped that the salutary revolution thus begun, would, ere long, deliver mankind from the yoke of bondage. Desirous, therefore, by every effort in his power, to promote this object, he, in 1641, published several controversial pamphlets respecting church government, and in opposition to Episcopacy. After the termination of this dispute, he conceived there were other two kinds of liberty equally worthy of attention, namely, civil and domestic; and while the magistrates boldly contended for the former, he used his powerful pen in favour of the latter, considering domestic liberty as involving three subjects,—marriage, the education of children, and the right of philosophising without restraint. He accordingly published several tracts upon the doctrine of divorce, education, and the liberty of the press.

In 1643, he married the daughter of Richard Powell, Esq. of Forrest-hill in Oxfordshire, who was a staunch royalist. This was a hastily concerted match; and the spouse of Milton, after a month's experience of her new life, which in her mind but ill accorded with the affluent hospitality to which she had been accustomed in her father's house, began to reflect on the gay pleasures she had exchanged for a life of solitude. Having, with consent of her husband, gone for a few weeks on a visit to Forrest-hill, either the attractive enjoyments of her paternal residence, or the persuasions of her relatives, who were opposed to the republican principles of her husband, induced her to protract her stay, and even to treat with silent contempt the letters of Milton urging her return. Exasperated by this provoking treatment, our author determined to repudiate his wife; and in justification of this measure, he in 1644, published his Essay on the Doctrine and Discipline of Divorce. He now therefore paid his addresses to the amiable and accomplished daughter of Dr. Davis, which incident affected Mrs Milton so seriously, that she purposely threw herself in his way at the house of a mutual friend, and, on her knees, acknowledged her fault, and earnestly supplicated his forgiveness. Milton at first seemed quite inflexible, but at length overcome by her tears and entreaties, all his former resolutions forsook him, and he became reconciled, and forgave her all that was past.

A fine allusion to this pathetic circumstance occurs in his Paradise Lost, B. X. v. 940, where, in expressing the feelings of Adam, it is said

> "Soon his heart relented
> Towards her, his life so late and sole delight,
> Now at his feet submissive in distress."

So far was Milton from entertaining the smallest resentment after this reconciliation, that, along with his wife, he received into his house the whole family of the Powells, who now required protection and assistance, in consequence of the failure of the royal cause. He saved the bulk of their property by means of his political influence; and they remained under his roof till about the year 1647.

While immersed in his controversy respecting divorce, he, in 1644, published his tract upon Education, which was soon followed by his Areopagitua, in which work he with great ability maintained the liberty of the press; and, in 1645, he prepared and published with his name, an edition of all his English, Italian, and Latin poems. His next work, published in 1642, was the Tenure of Kings and Magistrates, &c., wherein he discusses the abstract principles of human rights and regal responsibility, and asserts the right of the people to depose or put to death a king whenever he becomes a tyrant, in opposition to those who maintained that kings were from God, and not responsible to any earthly judge.

It being about this period resolved by the Commonwealth to communicate with foreign powers only through the medium of the old Roman language, Milton was appointed Latin secretary to the council of state; and his state papers written during his continuance in this department may be viewed as models of diplomatic composition. Shortly after entering on his new office, the appearance of the *Eikon Basilikè*, or portrait of his Sacred Majesty in his solitude and sufferings, in which he is represented in the habitual exercise of prayer, declaring the purity of his motives, and appealing to the justice of God from the injustice of man,—called forth Milton's *Iconoclastes*, or Image-breaker, wherein he contrasts the monarch's deeds with the piety ascribed to him. In 1651, he brought forward his *Defensio pro Populo Anglicano*, in answer to the *Defensio Regia*, which was a defence of the cause of royalty, prelacy, and the house of Stuart. By this performance, Milton spread his fame throughout Europe, and he obtained from the council of state a reward of L.1000 Sterling. In 1652, his wife died in child-bed, and about the same time his sight was impaired by over much study. Milton was retained in office by Cromwell, who possessed himself of the reins of government in 1653, and notwithstanding the entire loss of his sight he still devoted his leisure hours to study. His next wife was the daughter of Captain Woodstock of Hackney, who likewise died in child-bed about a year after marriage. The career of Cromwell came to an end in 1654, and his son Richard very judiciously descended to a private station. At this crisis Milton exerted himself in public affairs, and among other tracts which he published was one, "A ready and easy way to establish a Free Commonwealth; the excellencies thereof compared with the inconveniences and dangers of readmiting Monarchy." His sanguine attempts, however, with respect to his political system, proved abortive,—the king returned in triumph, and our author was glad to find a quiet retreat from danger in the house of a friend in Bartholomew's Close. A prosecution being now raised against him, it was merely in consideration of his unparalleled talents that he was afterwards included in the general amnesty. When his affairs became more prosperous, he took for a third wife the daughter of Mr Minshall, a gentleman of Cheshire, and settled in a house in the Artillery-Walk, where he applied himself to the completion of his invaluable poem of Paradise Lost. It was published in 1667, and the Paradise Regained appeared three years after. This illustrious scholar and poet died at his house in Bunhill-Fields in 1674, having reached the age of 66 years, and a monument was in 1737 erected to his memory in Westminster abbey by Mr Benson. By his will he left nearly L.2000, besides L.1000, his wife's portion, which remained in the hands of the Powells, to be paid to his three daughters.

Milton was remarkable for the elegance of his person, and for his manly deportment. He was a skilful swordsman, and an adept in music, and his learning embraced the Hebrew, Greek, Latin, Italian, and Spanish. To his merits as an epic poet, Dr. Johnson, who was prejudiced against him on account of his political views, pays ample reverence. "He was born," says that able critic, "for whatever is arduous, and his work is not the greatest of heroic poems only *because it is not the first*." Indeed it is sufficient evidence of the superlative vigour and magnificence of the poetry of Milton, that men of the brightest genius and discernment in literature have uniformly delighted in contemplating the beauties of the Paradise Lost. "If we call diction the garb of thought, Milton in his style may be said to wear the costume of sovereignty. The idioms of other languages contributed to adorn it. He was the most learned of poets, yet his learning interferes not with his substantial English purity."—Campbell's *Essay on English Poetry*.

Mr Todd's edition of the works of Milton, in 6 vols. 8vo, is considered the best; and the whole of his political writings were published in 3 vols. folio in London 1699.

MIMES, in the ancient comedy, were buffoons, who in their laughable entertainments ridiculed characters by their mimicry and gestures. These actors, who were introduced on the Roman stage when comedy and tragedy had attained great perfection, were dressed in lambskin, had their faces smeared with soot, and carried flowers and herbs in honour of Bacchus. Some of them acted their parts to the sound of the tibia, and were called mimauli, and the female performers were denominated mimae.

MIND, according to Dr Johnson, signifies, 1, the intelligent power; 2, liking, choice, inclination, propension, affection; 3, thoughts, sentiments; 4, opinion; 5, memory, remembrance;—an enumeration sufficiently ample to comprehend both metaphysics and ethics, taken in their usual sense, and, at the same time, sufficiently discriminating and appropriate to exclude all idea of the properties of matter. There is probably more good sense and sound philosophy in this aggregate definition than may appear at first sight to a reader who consults it for the purpose of finding a basis on which to erect his own system, whatever that may be, of mental science. It assumes nothing, it asserts nothing, it gives no support, direct or incidental, to any preconceived or established theory, but simply specifies the various particulars to which the word is applied in ordinary writing and discourse. Had mankind generally, or those especially who undertake, no matter on what principle, or with what talent, to guide and influence opinion, shewn equal moderation and prudence, the world would have been saved an immensity of idle controversy, and the incumbrance of many heavy books on the subject of mind, which, divested of the nonsense and subtleties of the schools, presents one of the most delightful, as well as most important fields, for the exercise of our powers of observation and reflection.

We obtain a knowledge of mind from two great sources, consciousness and observation; the former denoting the immediate acquaintance and internal perception we have of the sensations, thoughts, and operation of our own minds; and the latter being exercised on those actions and circumstances which, according to the constitution of our nature, we ascribe to similar principles in the animated beings around us. It is the business of philosophy to collect the facts discoverable by those two means, to arrange them in the order of their connections and relations, and, by a process of induction, to refer them to their real or apparent causes. Any system or theoretical view of mind must be defective which is erected on facts either incorrectly recorded, or too few in number to warrant general conclusions; in which the process of classification and arrangement is not purely and entirely such as is indicated by nature herself; or, lastly, the references of which either exclude what is really efficient, or comprehend what is merely imaginary. Consciousness alone is an inadequate guide to a true and complete system, both because it is necessarily limited in its range, and because its intimations, however extensive, must be held restricted to the case of individual minds, not one of which may exactly correspond with another, and it being quite certain that the individuals of mankind, not to speak of other sentient beings, in place of possessing one common consciousness, have each a consciousness peculiar to himself, and incommunicable to his fellows. Observation, on the other hand, might lead us far enough in the pursuit of truth, but could never impart that feeling, sense, and understanding of our various powers and affections, which are essential to a just exposition of their nature and properties. Consciousness and observation, therefore, must both be exercised, and, it is obvious, their results or dictates must perfectly harmonize in the formation of a true theory of the mind. Some incidental sources of error are likewise to be guarded against, more especially two;—the imperfections of language, considered either as an instrument of thought, or the means by which we hold correspondence with other thinking beings; and a great variety of preconceived or established opinions on the subject of mind, the effect of any one of which, if long continued, is to generate a habit of specific limited belief, that is utterly inconsistent with scientific examination. But consciousness and observation may both have been exercised, and their results found to harmonize,—the imperfections of language may have been remedied by a strict regard to definition, and the evil agency of hypothesis avoided by a manly devotion to truth,—and yet, after all, we may fall short of a just and complete theory, plainly because of obstacles insuperable by human industry, and apparently placed in our way to teach us sobriety of judgment, and convince us of the existence of a power and a wisdom infinitely surpassing our own. Of the nature of these obstacles we may form some conception, though the question as to their amount is itself beyond our ability to solve, by enumerating a few points connected with the subject of mind, which the labours of many thousand generations have left as inexplicable as they were found to be by the first cultivators of intellectual science.

We do not know what the mind is in itself, not even our own mind, to which we have direct access by consciousness, far less, if possible, of the mind of any other intelligent being. Of its operations and powers we derive some information from the sources already mentioned; but its essential nature, substance, or constitution, is entirely concealed from us. To speak, therefore, of its materiality or immateriality, is to speak of what we do not understand, to appear wise on the basis of ignorance, and at the expense of our modesty. The essence of matter is equally unknown to us, its properties and qualities alone coming under our notice. It follows, consequently, that we are not entitled to suppose, much less assert positively, that the essence of matter and the essence of mind are perfectly distinct and different, though we are certainly at liberty to infer, from what we do know of their respective properties, that it is impossible for us to believe or imagine they are one and the same. But, on either supposition, that is, whether they be essentially distinct, or essentially the same, though incidentally and temporally endowed with different qualities, we are equally ignorant of the precise nature of the union and relation which subsists between them in our own constitutions and in the constitutions of those beings who resemble us. We cannot tell at what period of our existence, reckoning from the first moment of our being organised in the womb, this union was established; for it is certain, that consciousness does not convey to us this intelligence, nor carry us far enough back to ascertain it; and it is equally certain, that observation on other animated beings leaves us quite in the dark as to the question. Farther, setting aside what revelation may impart, we do not know at what precise moment this union is dissolved; for, not to speak of consciousness, which, of course, while we are in the body and animate it, is silent in the matter, there are many incontrovertible evidences to shew, that the union is not always finally broken, when the powers of life which indicated it appear to be extinguished. How this union is preserved, or how, by the proper use of nourishing food, which undoubtedly supports the bodily frame, this union is continued, is also a mystery, and cannot be accounted for, whether we believe the mind, as to its nature, to be different from or the same as the substance of which the body is composed. The decomposition of the body into its chemical elements, or, at least, the resolution of it, after death, into disorganised parts, is abundantly well known to us; but what becomes of its former intimate companion, when, on this event, severed from it, our natural powers can by no means determine; and, even with the light of Scripture before us, it is problematical whether the mind, supposing it immaterial, is entirely divested, and continues for a time divested of all material abode and organ, retains a particular portion of the old one, or is instantaneously provided with another. On these points the most zealous supporters and most learned commentators of Scripture are by no means agreed. The origin, it seems, then, the manner of continuance, and the time and mode of the breaking up of the union of mind and body, are not discoverable by our natural faculties—are not patent, beyond the possibility of mistake, either to our consciousness, while we are actually experiencing the union, or to our powers of observation, though many instances of that union are passing daily before us.

But the phenomena which occur during the alliance of mind and body likewise present some difficulties, which, without offence to philosophy, may be said still to remain insuperable; while others, if they admit of explication at all, admit only of such as is merely probable, and not altogether satisfactory. One greatly perplexing question immediately presents itself to us, in considering this subject. What is the nature of that intercourse which we hold with the external world,—or, in other words, what is the relation which subsists between the things around us, including the dependencies on time, and that state of our minds, of our thinking and feeling selves, which comprehends both what we call our knowledge of these things and their influence on us as to enjoying, suffering, desiring, disliking, in short, as to our modes of being? It is not sufficient, in answer to this question, to say that there is a correspondence, or harmony, established between our minds and the external world, so that the one perfectly concides with the other, and that therefore our conceptions or ideas of things have their archetypes in nature. The fact may be admitted, but our inquiry regards both the mode in which this correspondence is effected, and the sort of resemblance which is imagined by us to subsist between the realities around us, and the thoughts of our minds; so that the latter, not only suggest the former but also imply their separate existence. We have the evidence of consciousness, that impressions are made on our bodily organs by outward objects, and that, immediately thereafter, certain ideas are produced in our minds, and certain desires or aversions, certain propensities or emotions, excited within us, prompting us to act in particular manners with respect to what is without; but, hitherto, no satisfactory theory has been given as to the nature of this connection and mutual operation. We are quite in the dark, in reality, as to the connection between the impressions made on our systems, and the ideas arising in our minds; and also between the volitions of our minds, and the consequent actions of our bodily organs. So far as we know, the ideas of our minds, instantaneously as they may suggest the qualities of bodies, so that in many cases we are at a loss to determine where sensation terminates and perception commences, do not at all participate in the essence of these qualities, and can by no means be supposed to emanate from them; but a conviction to this effect, philosophical as it may be, leaves the difficulty as to the connection in full force, and in all its magnitude. If we be thus at a loss to explain the dependence of sensation and perception, we are no less so to account for the phenomena of memory—how certain ideas, retained in the mind, occasion, or are connected with the belief, not that the things to which they belong, or which they suggest, now exist, but that they formerly existed, and were objects either of our perceptive or reflective powers, though no longer subjected to them; while, in other cases, such ideas of memory may be so vivid as to occasion a momentary belief in the present existence of their archetypes. Again, we are puzzled as to the reason why some ideas are preserved longer, and revived more readily, than others, though, so far as volition is concerned, we may have given the preference to the latter at the time of their first occurrence. Moreover, some ideas seem to force themselves upon us in spite of all our efforts to get rid of them, whereas others, which we may have resolved always to bear about with us, refuse their fellowship, even at periods when we most require their aid. This, which is a difficulty of the same kind as the preceding, leads us to the statement of another question of primary importance in the theory of mind, but exceedingly obscure and hard of solution, namely, whether the mind be one and indivisible, though existing in different states at different times, or be a compound of various powers and faculties, any two or more of which may be exercised at the same time?

Many other difficulties, strongly pointing out the extent of our ignorance, or implying the imperfection of our knowledge, might be enumerated, both as respects the healthy state of the mind, and its condition in what are perhaps improperly denominated its diseases; but these, fairly appreciated, will answer the purpose now in view, which is to prove the reasonableness of humility, and the folly of arrogance, fashionable as the theory may be on which it is built, touching this most complex, intricate, and unaccommodating department of science, and, in consequence, to induce a simplicity and candour of disposition which would be gratified by the communication of knowledge respecting it, however limited in degree, and however opposed to prevalent taste the channel through which it is transmitted.

If we attend to what passes within us, or, to use a current phrase, reflect on the objects of our own consciousness, we shall discover, among many other phenomena, the following particulars: While we are awake, and often when we are asleep, but dream, there is a succession of impressions on our bodily frames; a consequent succession of perceptions respecting external objects, comprehending the actions of other sentient and intelligent beings; and another succession, sometimes consequent on the two former, of emotions, propensities, desires, and aversions, hopes and fears, prompting us to act, or so to exercise the faculties of our minds, and the members of our bodies, as to seek to attain, avoid, or oppose certain objects which are brought within the sphere of our knowledge and concern. At times we can arrest the progress of these successions and changes in such a manner, or to such a degree, as permits our reviewing or attentively regarding them; and to this process we are occasionally excited both by the circumstance of their being either very pleasant or very disagreeable to us, and the persuasion, whether arising from experience or any other source, that our subsequent welfare is materially dependent on our present deliberations. At other times, the successions both in sensations, perceptions, propensities, and volitions, are too rapid or too vivid to admit of such delay, and the consequence is the immediate putting forth of some act, or an effort towards the accomplishment of some purpose, by means of those bodily instruments which are subjected to the dominion of the will, though in a way very incomprehensible to us. Besides sensations, which, to be felt, must be present, perceptions the very experience of which implies the immediate existence of corresponding objects and qualities, and the deliberations of our intellectual and moral powers, which carry us actively forward into future times and events, we are conscious of a long and varied array of thoughts and feelings which unaccountably connect our present selves with a preceding condition, and with circumstances no longer existing or operating on us, but which formerly as much concerned us as any with which we are now occupied. Farther, we are conscious that we can both combine together ideas, not in such a manner as that in which they presented themselves to us, or in which they have exact correspondencies in nature, but so as to form new compounds, which have no existence save in our minds; and that we can decompose such ideas as were originally presented complex, so as to make any one part of them a distinct and separate object of reflection. Our consciousness seems to pervade our whole bodily systems, so that we not only are sensible of various impressions made on its various organs and members, but also are led to conceive that these organs and members actually form part of ourselves. Such, in few words, is an outline of what consciousness discovers to us, and it is evident that, in reviewing it, and still more in attending to the dictates of consciousness itself, there is a close and highly important relation between our minds, whatever these may be, and our corporeal organization. The phenomena of health and disease, of dreaming, somnambulism, and other states, all go to confirm this belief, which is farther enforced by what is known of the successive developement, maturity, and decay of our faculties being dependent on corresponding developements and changes in the state of our bodily frames. If, in addition to what consciousness thus suggests, we have recourse to observation, we shall find that all the mental powers of our fellow creatures are manifested through the medium of bodily organs. The remark applies equally to the very highest powers of which our nature is susceptible, as to those of the lowest order which we have in common with the brutes. It would seem, then, a perfectly correct and philosophical inquiry, What are the portions of our organized bodies with which our minds are most intimately connected? and, again, as it is most certain that we have not only different degrees, but also different kinds of mental powers, some distinctions in which have already been enumerated, are there any differences in those portions, wherever situated, corresponding with such mental powers?

Sensation is of different kinds, and is assuredly performed by different organs,—or, in other words, different parts of our bodily system are appropriated to different senses. It would be quite according to analogy to infer that other faculties of mind have their specific organs, though we might never be able to discover where they are placed. It is quite conceivable, too, that even though, by some means or other, they were discovered, so that we should be entitled to say with confidence, that such and such portions of our bodies were the instruments by which the mind manifested such and such powers, we might be nevertheless completely in the dark both as to the mode in which these portions were so employed, and also as to the precise kind of connection, not to speak of resemblance, which would be nonsensical, subsisting between them. The case of the organs of the senses is quite in point here. Our knowledge of the structure of the eye, of the exact similitude it bears to an optical instrument, by no means accounts for the mode in which the mind sees by means of it; for though we have discovered the production of pictures on the retina, we cannot explain how these pictures are perceived by an agent, or intelligent being, which is positively not only altogether unconscious of them, but is actually conscious of seeing the things which they resemble in a very different position and place. The same thing may be said of the sense of hearing, in which our knowledge of the anatomical structure of the organ concerned in it aids us not at all in the exposition of the general phenomenon; and we may extend the observation to all the other senses, between which and the perceptions we make by means of them we can trace no similitude. Should the case be the same with respect to any of the higher powers, and their supposed organs, it would be foolish for us either to be surprised, or to consider the circumstance as an objection to the discovery of their relation and connection.

Enough has been said, perhaps, to shew the necessity of cultivating the science of mind, not, as has often been done, by reflection on the objects of consciousness alone, but in dependence on and in alliance with those organized systems by which the powers and properties of mind are manifested, and separate from which, it is certain, the existence of mind is not discoverable by any of our faculties. If farther proof of this necessity were requisite, it is abundantly supplied in the history of the science itself, from which we learn the mortifying but most salutary truth, that no ingenuity, no excellence of talent, no perseverance in the solitary abstract study in which the metaphysicians have indulged, has hitherto been so successful as to recommend a process of investigation, the very first principle of which is the hypothetical disjunction of two things which nature always presents to us combined and mutually influential. Some thousands of years have been spent in pursuing this process, the general adoption of which is perfectly consistent, be it remarked, with numberless peculiarities of theory; it is surely full time that mankind, perceiving its unprofitableness, and regretting as worse than lost the labours of those who engaged in it, should have recourse to another, the essential advantage of which is, that it respects as inviolable a harmony and an alliance as old as the creation. *Vide* PHRENOLOGY.

One great source of the perplexities in which the question regarding the future existence of the thinking principle has long been involved, is the notion of certain theologians, remarkable for zeal rather than judgment, that the sentiments entertained by any one respecting the essence of the mind, must be conclusive as to his belief concerning its immortality. But there cannot be a greater absurdity than the supposition of any such necessary connection. He who thinks he can conceive, and surely a man may very conscientiously think he can conceive, that Almighty power is competent to endow matter with the faculties of feeling, and reasoning, and acting, may and will readily admit, that the same power is competent to bestow perpetuity of existence on the portions of matter so endowed; whilst, on the other hand, it would be a degree of arrogance, amounting to impiety, to assert, that mind, presumed to be something altogether distinct from matter, is not dependent on the will of the Maker and Governor of all things for its continuance of being. Meekness of wisdom would lead to much sobriety of thought, and very guarded language, on a topic so remote from the concerns of daily life; and the interest and import of which, if susceptible of due appreciation by any order of created intelligence, are, at all events, not patent to the sons of men. We find, accordingly, that the inspired writers never once venture on the discussion. They speak intelligibly and pointedly as to what will be the future conditions of responsible agents, but those conditions are not deduced by them as logical inferences from any process of reasoning; and the genuine partakers of their faith, it is probable, will have little relish, and undoubtedly see no occasion, for the speculations on the subject which have successively arisen to amuse the world. The hope that is built on a divine record needs not any strength derived from inferior authority, though our belief in a doctrine must be confirmed by our perceiving it to be reconcileable with the principles of our constitution. A sound reasoner, accordingly, would argue rather from the powers and relations of the mind, than from any assumptions regarding its essence, in support of what revelation teaches us on this most important subject; and, it is well known, the consideration of these powers and relations induced the wisest and best of the ancient philosophers to think that a future state, a state of rewards and punishments, was highly probable.

The difference, manifested and plainly discoverable, between mankind and the lower animals, in respect to some of their powers, is a difference in kind, not merely in degree, and seems entitled to almost unqualified authority in determining the question as to their final disposal. A recent writer, advocating phrenology, has availed himself of its alleged discoveries to state this argument in a very forcible manner, as may be seen from the following extract: "It may be asked, since all access is denied to the discovery of the substance of which the mind is made, whether all light is withheld *by nature*, independently of revelation, respecting the mortality or immortality of man? By no means. From contemplating the powers of the mind itself, and the relations which they bear to this world and to hereafter, we may draw conclusions, possessing a high degree of probability, concerning the object of man's creation. When we find phrenology demonstrating the existence, in the human mind, of a faculty of veneration, which longs to know intimately a God whom it may worship;—a faculty of hope, soaring beyond the boundaries of time, and expatiating in the fields of an eternity to come, as its dwelling-place;—a faculty of conscientiousness, desiring to see virtue crowned with its just reward;—a faculty of benevolence, longing to contemplate happiness diffused as widely as space extends, and as endless in duration as eternity;—and intellectual powers, insatiable in their desire to discover and to contemplate the wonders of creation; in short, faculties all pointing to a future and a higher state of being, as the aim and object of their existence;—we may infer that this world is not the scene in which are to close for ever the destinies of man. Aside from revelation, it is from sources such as these,—from the constitution of the mind, and its relation to objects present and to come,—that its ultimate destiny must be inferred, by the *understanding*, although not as an object of sense; and if we regard these with an enlightened desire of arriving at sound conclusions, we shall find much presumptive evidence that man is destined for immortality."

But, how inconsiderable the support that is given by mere reasoning to the revelation which hath brought "life and immortality to light" really is, may be shewn by a brief statement of the argument on the subject advanced by Bishop Butler.

The object of that chapter of his admirable Analogy, namely, the first, which treats "of a future life," may be considered a philosophical and circumstantial reply to the question, "What do our experience and observation teach us as to the probable effect of death upon that thinking, intelligent principle, or being, which every man calls himself?" In other words, is it probable, reasoning on the analogy of nature, so far as it is known to us, that we, our real selves, as distinguished from the organized mass of matter constituting our bodies, which serve as a vehicle and apparatus to us, may survive the separation, removal, and complete destruction of these bodies, in the event of death, so that we may still remain conscious of existence, though in a different state from the present, and continue to possess some powers or faculties of perception and understanding? The reply is drawn from three sources.

1. It is a general law of nature in our own species, and which extends also to the lower animals, that the same individuals,—the same, be it remarked, in the sense of the word identity, the continuance of which, we know, is quite consistent with changes in form, and even in properties,—have different degrees of life and perception, different capacities and powers of acting, enjoying, and suffering, in different stages of their being. With respect to ourselves, the difference between our present state and that which we had when in the womb, or even during infancy, is particularly specified by Bishop Butler, as being equal to any which it is possible for us to conceive we shall ever experience. Hence the inference is contended for, that any change from our present condition to one consequent on the separation or disunion of mind and body,—or, in other words, on the death of the latter,—would be only according to the analogy of nature.

2. The present possession of the powers of acting, enjoying, and suffering, affords a presumption that

we shall always possess them, unless we have reason to believe that some event or circumstance, no matter what, will deprive us of them. This presumption is founded on what is held to be an ultimate principle in our constitution, or, at least, a principle of belief common to all mankind, and of which, perhaps, no satisfactory explanation can be given, namely, that things will continue in all respects as they are, unless where, from experience or some other reason, we are led to expect a change. Now, it is alleged in this case, that neither experience, nor any reason which it is possible to assign, can give us ground for apprehending that the event of death will deprive us of these powers, considered as different from the means and instruments, that is, the bodily organs, by which the existence of them is made manifest to other beings. In short, nothing that we know can afford us reason to think, that the powers of a living being, considered in this sense, can be lost, or will be annihilated in any event, although we are well assured, from daily observation, that a particular event interrupts or prevents the sensible indication of their existence. All the knowledge we have of death, it may be said, is that of its effects on the body; but, what it is in itself, or what is its operation on the living being which formerly animated his body, no man can tell, and it is impossible to ascertain except by personal experience. For aught we know, then, its effect on the living being may be so far from anything of the nature of an impediment or obstruction to its capacities for activity and enjoyment, that it may be the removal of all difficulties in the way of their exercise, as it certainly is the outlet from all present miseries and afflictions. Both the existence, therefore, and the exercise of our living powers, may, for aught we know, depend on something nowise affected by that most interesting event, or, indeed, may be even bettered by it. "Besides," says the bishop, "as we are greatly in the dark upon what the exercise of our living powers depends, so we are wholly ignorant what the powers themselves depend upon; the powers themselves, as distinguished not only from their actual exercise, but also from the present capacity of exercising them, and as opposed to their destruction: for sleep, or however a swoon, shews us, not only that these powers exist when they are not exercised, as the passive power of motion does in inanimate matter, but shews also that they exist, when there is no present capacity of exercising them: or that the capacities of exercising them for the present, as well as the actual exercise of them, may be suspended, and yet the powers themselves remain undestroyed. Since, then, we know not at all upon what the existence of our living powers depends, this shews, further, there can no probability be collected from the reason of the thing, that death will be their destruction: because their existence may depend upon somewhat in no degree affected by death, upon somewhat quite out of the reach of this king of terrors. So that there is nothing more certain, than that *the reason of the thing* shews us no connection between death and the destruction of living agents. Nor can we find any thing throughout the whole *analogy of nature*, to afford us even the slightest presumption that animals ever lose their living powers; much less, if it were possible, that they lose them by death; for we have no faculties wherewith to trace any beyond, or through it, so as to see what becomes of them. This event removes them from our view. It destroys the *sensible* proof, which we had before their death, of their being possessed of living powers, but does not appear to afford the least reason to believe that they are, then, or by that event, deprived of them." Farther, it may be stated, all the presumptions of an unpleasant or melancholy nature, that death will be the destruction of our living powers, seem to be founded on certain early prejudices, and on the habit, which we see operates on many other subjects, of confounding together things which are really distinct, and not necessarily, nay, not even constantly, conjoined,—as, in this case, the *existence* of living powers, the *exercise* of them, the *power of exercising* them, and the *indication of their existence.*

3. We must distinguish between a state of perception or sensation, by means of bodily organs, and a state of reflection, that is, of the exercise of the powers of reason, memory, and affection. It is certain that we now exist in both those states; but we can readily conceive the existence of one without the other; and we learn from experience, that, on certain occasions, we are to all appearance under the peculiar influence of either of them exclusively. Thus sensation is frequently carried on without the conscious exercise of any of the higher powers of living beings, so that while subjected to its influence, man may be said to bear a resemblance to the lower animals; and, on the other hand, there are probably few persons who do not know that they sometimes exercise those higher powers when sensation is seemingly suspended or interrupted. Now the state of sensation may be requisite, it is true, according to our present constitution, as a medium for the acquisition of the materials on which reflection is to be exercised; but it does not follow that, after these materials are acquired, the state of sensation may not be entirely removed, or broken up, without the destruction or annihilation of the power of reflection. Analogy would incline us to think very differently, for we find that certain parts of the system of sensation may be destroyed, and that, notwithstanding the loss, the exercise of reflection on the materials acquired through these parts may be carried on as well as ever. The relation of our material bodies, to what we call ourselves, it may be conceded, therefore, is not essential to the exercise of thought, and, consequently, may be dissolved without any injury to our powers of reasoning, enjoying, or suffering. It is, indeed, by a principle in our nature, that, during the present state of connection between the two systems of sensation and reflection, they mutually affect each other according to certain laws and to a certain degree; but no presumption can hence arise, that, when this connection is done away, one of these systems cannot, or shall not still go on, according to its own laws, or according to some new or additional laws, appointed by the author of nature. What these are, it may not be possible for us to determine,—any more than

it is possible for a child in the womb to determine what will be the laws of its existence when it shall be brought into the world. "So that," infers the bishop, "our posthumous life, whatever there may be in it additional to our present, yet may not be entirely beginning anew, but going on. Death may, in some sort, and in some respects, answer to our birth, which is not a suspension of the faculties which we had before it, or a total change of the state of life in which we existed when in the womb, but a continuation of both, with such and such great alterations. Nay, for aught we know of ourselves, of our present life, and of death, death may immediately, in the natural course of things, put us into a higher and more enlarged state of life, as our birth does; a state in which our capacities, and sphere of perception and of action, may be much greater than at present." "And thus, when we go out of this world," continues he, "we may pass into new scenes, and a new state of life and action, just as naturally as we came into the present."

This much may serve as an analysis of the bishop's reply to the question above stated. It is proper now to consider the parts of it separately, and in so doing we shall have occasion to treat of several topics connected with the general subject of mind.

The strength of the first argument seems to depend on a principle taken for granted, that there is in our constitution, and also in that of the lower animals susceptible of the changes alluded to, something different from their gross material bodies, and that this, whatever it is, does not, and cannot undergo, as to its nature, though it may as to some of its properties and powers, any alteration in consequence of the changes through which these bodies pass. It is obvious, that, were this principle false, or unfounded in the constitution of our nature, the argument, from analogy, as to our future existence, drawn from the circumstance of our having existed in a state very different from our present, would lose its validity; because we have the fullest evidence which it is possible to obtain on such a subject, that the system which formerly manifested living powers is broken up and reduced to its component elements by the event of death. Accordingly, even admitting another principle assumed by the bishop, namely, "that there is in every case a probability that all things will continue as we experience they are, in all respects, except those in which we have some reason to think they will be altered," with every inference logically deducible from it, we might contend, on the ground now stated, that the effect of death, as ascertained by observation, is such as to afford us the strongest reason for thinking, that the things which the argument supposes to continue will be altered, if not destroyed. The bishop, then, must first of all prove the right to use this principle, in other words, prove that there does exist in our constitution something distinct from our material bodies, and also that it is capable, from its own nature, of remaining in its present state, notwithstanding the changes and the destruction to which our bodies are liable. His reasoning must necessarily be deemed inconclusive by the materialist, who, nevertheless, may most confidently believe in a future state of existence, as revealed in the gospel, and, as he may allege, from a persuasion, that divine wisdom cannot err in the selection of a suitable nature or substance for the mind, and divine power is quite competent to the preservation of that nature beyond all assignable limit and against all imaginable agents.

But, again, though the principle assumed by the bishop were admitted, there is ground, says an opponent, for apprehending that this argument, from analogy, either fails where it is most needed, or goes farther than is convenient for the system intended to be defended by it. The bishop has spoken of the changes of the material bodies alone, and seems not to have attended to those which the being or thing held to be distinct from these bodies, according to his own hypothesis, has undergone, and may yet undergo. Now, on the supposition, which there can be no doubt was entertained by him, that this being has been connected with a material body from the commencement of its existence as an organised system, it is reasonable to imagine, and perhaps it will not be denied, that the changes which this being has undergone are not less than those of the material body itself. It formerly existed, we have reason to believe, without consciousness or memory, almost without perception or sensation, and we know, from the phenomenon of sleep, that it can exist without exercising them; so that, comparing our present state, especially our active state, in which we have all these powers, and in which we are conscious of exercising them, with that preceding one, we are quite unable to trace the resemblance between them, or to identify what we now are with what we formerly were. On the ground of analogy itself, then, may we not say, that, if we shall exist hereafter in a state separate from the body, which all along, be it remarked, served as a connecting medium between our various states, it is probable we shall do so in such a manner as that we shall retain little or no recollection of our former selves, and be so devoid of conscious identity, that we cannot be proper subjects for the exercise of retributive judgment, which is, unquestionably, the chief thing intended to be maintained by the bishop on the argument now discussed? Such a change as this would amount to, seems, in fact, equivalent to a new creation, which, accordingly, we had far better at once suppose or expect, without any argument at all, than be at the trouble, unsatisfactory as we see it turns out to be, of reasoning about what *may be* from any thing that *now is*. Such is the train of reasoning made use of by the bishop's opponents.

Moreover, it is not denied by Bishop Butler, say they, that there sometimes does arise in the mind a suspicion that death, which is so very formidable to the body, may prove equally so to the mind. He was well aware of it, and states it, in order to obviate it, in the following manner: "Though I think it must be acknowledged that, prior to the natural and moral proofs of a future life commonly insisted upon, there would arise a general confused suspicion, that in the great shock and alteration which we shall undergo by death, we, *i. e.* our living powers, might be wholly destroyed; yet, even prior to those proofs, there is really no distinct ground or reason for this apprehension at all, so far as I can find." By the destruction of living powers he means, as he mentions in a note, not merely a destruction of the means and instruments, such as our senses, which the mind uses in carrying on its operations, but the destruction of the living agent itself which employs them. This suspicion is probably a consequence of our having almost constantly associated together the ideas of mind and active power with those of certain properties of matter. But, be its origin what it may, the bishop's mode of obviating it, however ingenious, is unsatisfactory. If there " be any ground or reason for it," says he, " it must either arise from the reason of the thing or from analogy." " We cannot argue from the reason of the thing, that death is the destruction of living agents, because we know not at all what death is in itself, but only some of its effects, such as the dissolution of flesh, skin, and bones; and these effects do in nowise appear to imply the destruction of a living agent." Very true, but it is an effect only of a similar nature, and occurring simultaneously, for which an advocate of the contrary doctrine would contend; and this effect may be imagined very likely to accompany the destruction of the body, as the faculties themselves of the mind are discoverable only in connection with the living body. Previously to experience, it is clear, we never should have expected that the event of death would be attended with those effects on the body which we see it to produce, and know to be connected with it; and the same arguments which Bishop B. here urges, might have been applied against such a suspicion respecting that effect of death. If, then, the argument, from the reason of the thing, do not support the suspicion, neither can it be brought against that suspicion; indeed, it stands opposed to any merely hypothetical reasoning by which it is attempted to be overthrown. It is very true, that " as we are greatly in the dark upon what the exercise of our living powers depends, so we are wholly ignorant what the powers themselves depend upon;" but this darkness and ignorance, which are as compatible with the materiality of the living agent on which they depend as with its immateriality, can at best only afford us, as we have seen, the negative conclusion, " that there can no probability be collected from the reason of the thing, that death will be the destruction of the living powers;" against which, it is obvious, the analogy of nature, in the instance of the known effects of death on the body, remains in full force. Hence, then, the suspicion may, and, it is believed, very frequently does exist, even when the conclusion of the bishop is assented to. He seems to have anticipated this objection, and accordingly says, " however, as one cannot but be greatly sensible how difficult it is to silence imagination enough to make the voice of reason even distinctly heard in this case, &c. it may be proper to consider the imaginary presumptions that death will be our destruction, arising from those kinds of early and *lasting* prejudices, and to shew how little they can really amount to, *even though we cannot wholly divest ourselves of them.*" Here, certainly, he makes a considerable concession to what may safely be called the natural feelings of mankind on this subject. Let us see how he proposes to set them aside, or provide a remedy for them.

First, then, he says: " All *presumption* of death's being the dissolution of living beings must go on the supposition that they are compounded, and so discerptible." In order to obviate this, he endeavours to prove that living beings are not compounded, thus: " Since consciousness is a single and indivisible power, it should seem that the subject in which it resides must be so too." But, granting it were, which, however, there is no necessity for doing, if it cannot be proved that the other faculties of the mind are not only single and indivisible powers, but reside in the same subject with consciousness, there can be no ground for supposing that living beings are not compounded. Consciousness, for aught we know, may reside in one subject, or part of a subject, and the various faculties in another and a distant one, or in several parts; so that although the former be single and indivisible, and the subject in which it resides be so too, still the other faculties may be compounded as well as the subjects in which they reside, and, consequently, may be discerptible. Not to take into account, therefore, what may be urged against the supposition of consciousness being single and indivisible, which, at all events, is not a necessary nor a perfectly obvious truth, it is clear that the inference of the bishop is not entitled to command our assent. The case of motion in a particle of matter, adduced by him in support of his argument, does not seem to be in point; for there is no resemblance between such motion and the power of consciousness; nor is it easy to see how what may be properly predicated of the one is necessarily true as to the other. On the whole, then, say his opponents, this part of his argument appears defective and inconclusive.

Secondly, admitting that the simplicity and absolute oneness of a living agent, for which he contends as necessary to his views, cannot, from the nature of the thing, be proved by experimental observations, he says, that as they are, however, connected, or, to use his own words, *fall in with the supposition* of its unity, so ' they plainly lead us to conclude certainly, that our gross organized bodies with which we perceive the objects of sense, and with which we act, are no part of ourselves, and therefore shew us that we have no reason to believe their destruction to be ours, even without determining whether our living substances be material or immaterial." Without availing ourselves of the concession here made, let us attend to several particulars comprehended under this head. 1. " That we have no way of determining by experience what is the certain bulk of the living being each man calls himself; and yet, till it be determined that it is larger in bulk than the solid elementary principles of matter, which there is no ground to think any natural power can dissolve, there is no sort of reason to think death to be the dissolution of it, of the living being, even though it should not be absolutely indiscerptible." Here it seems as if the Bishop had connected together the notions of dissolution or destruction and a certain degree of magnitude, as if magnitude were essentially necessary to the susceptibility of destruction. But if annihilation be a species of destruction, and no one can doubt that it is, the conception is as easy that an immaterial being may be destroyed as that a piece of matter, a foot square of wood, for example, should be destroyed. It is not, therefore, required to be demonstrated that what each man call himself is larger than the solid elementary particles of matter, in order to shew a reason why it is susceptible of destruction. Moreover, it is obvious, the bishop's argument is quite as valid for the materialist as for the immaterialist. 2. "From our being so nearly related to and interested in certain systems of matter, suppose our flesh and bones, and afterwards ceasing to be at all related to them, the living agents themselves remaining all the while undestroyed, notwithstanding such alienation, and, consequently, these systems of matter not being ourselves, it follows, farther, that we have no ground to conclude any other, suppose *internal systems* of matter, to be the living agents themselves," &c. Admitting this, it must also be admitted, that the circumstances alluded to are no more inconsistent with the supposition than the circumstance of a piece of wood burning at one end, while one holds it at the other without feeling pain, is inconsistent with the supposition, that were the individual to put his hand into the fire he would suffer pain. The argument drawn from the removal or destruction of certain members of the body not being accompanied by that of the living agent is by no means conclusive; for it does not follow, that, because an arm or a leg can be amputated without the living agent being destroyed, therefore the living agent will remain uninjured when the head is severed from the body, or when both body and head are mouldering in the grave. In reality, as the bishop himself allows, the sensible evidence of the living agent continuing to exist is done away in this case. He says, that the relation a person bears to those parts of his body to which he is the most nearly related amounts to this, "that the living agent and those parts of the body mutually affect each other." Now, as it is from this mutual affection, seen and experienced, that we infer the existence of the former, may we not also infer, when, by the stroke of death, their sensible evidence is withdrawn, that it no longer exists? Such reasoning, it is clear, can never do away the imagination that the dissolution of a certain portion of matter is somehow connected with the destruction of a living agent. The same may be said of the arguments contained under the *third* more particular head, namely, that "if we consider our body somewhat more distinctly as made up of organs and instruments of perception and of motion, it will bring us to the same conclusion. Thus the common optical experiments shew, and even the observation how sight is assisted by glasses shews, that we see with our eyes in the same sense as we see with glasses," &c. The observations, it is granted, are strictly philosophical, correct, and ingenious; and they have been extended, it is curious enough, by Spurzheim and his followers, to the brain, which they do not consider to be the mind, as has ignorantly, if not malignantly, been charged on them, but merely the organ by which the mind, whatever it is,—and of this they pretend not to know any thing,—carries on and manifests its operations. Farther, the conclusion to which these observations, comprehending also this extension, lead, may be freely admitted, namely, "Upon the whole, then, our organs of sense and our limbs are certainly instruments which the living persons ourselves make use of to perceive and move with: there is not any probability that they are any more, nor, consequently, that we have any other kind of relation to them than what we may have to any other foreign matter formed into instruments of perception and motion, suppose into a microscope or a staff, (I say any other kind of relation, for I am not speaking of the degree of it,) nor, consequently, is there any probabability that the alienation or dissolution of these instruments is the destruction of the perceiving and moving agent:" Still, however, reply the bishop's opponents, it remains supposable, and it is submitted to every reader who chuses to pay attention to his own feelings and thoughts on the subject, whether it do not seem probable, that although the dissolution of the instruments be not accompanied with that of the living agent, yet that the dissolution of some other portion of matter, and especially of the whole body, may be accompanied with the extinction of the living agent? They even do not hesitate to say, that no argument advanced by the Bishop,—no reasoning on merely natural principles,—is sufficient to set aside this apprehension, and to render this probability improbable. The Bishop's reply to the objection brought against him, that his system comprehends and implies the immortality of brutes as well as that of mankind, appears quite effective, but need not be regarded in this place.

But in addition to all that has now been stated in discussing the bishop's second general argument, it must be remarked, that the presumption which constitutes its main strength is founded on an alleged principle of our constitution, which, though admitted to be an original principle, cannot, on that account alone, be held of sufficient authority to determine any thing about the course of nature, out of or beyond that constitution. It may, to be sure, be a law of our constitution, that *we think* all things will continue as they are, unless we have some reason to think they will be altered. But it does not follow from it, that all things *will continue* as they are;—on the contrary, it is quite conceiveable, and, for aught we know, it may be the case, that some good purpose is served by such a law of our constitution, although the course of events be, by no means, suitable to it,—rather, indeed, be very much the reverse. Thus, in the same manner, the principle which some have considered to be also an original one, that we always give credit to the assertions of mankind, even prior to the proof of their veracity, and unless we have some reason, from experience, or other ground, to discredit them, may, and does answer a good purpose, although the course of events be often very contrary to what it seems to imply. Here a general remark may be hazarded, of no small consequence. It is absurd to suppose that any principle of our constitution, merely because it is original, may be indulged or exercised without restraint, and so as to have always a good result, or to promote our real interest. A conduct the very reverse, in reality, namely, self-denial, which is often, be it observed, our bounden duty, proves most conducive to our welfare. Our original principles, whether moral, intellectual, or merely animal, may be considered as good in their proper places, and when under the guidance and control of what is appointed for their government; but it is matter of common notoriety, that any one of them may be improperly directed, or may be employed excessively, and become, in consequence, directly injurious to our best interests. But to proceed. The principle of belief, on which is founded the perception expressed by the word *continuance*, is supposed to be an original principle in our constitution, perhaps for this reason that it is found generally to exist among our species. On the same ground, may we not assert, that the confused suspicion, as it is called by the bishop, that, in the great shock and alteration which we shall undergo by death, " we, *i. e.* our living powers, will be destroyed," also depends on an original principle in our constitution, of equally great authority? And does not the affirmative opinion seem to derive confirmation from our peculiar solicitude to preserve our lives, *i. e.* to prevent death? This solicitude, it is worthy of notice, is quite suitable to such a suspicion; whereas, which is astonishing on the ground here assumed, our belief that things will continue as they are, in the course of nature, does not usually induce confidence on our part in the dispensations and providence of the Author of that nature, man being just as restless and full of anxiety as it is possible to conceive he would be without any such principle as is here supposed to be assigned to him. The truth is, the same answer is to be given in this case that has been given in another, namely, the principle contended for may exist, and may be productive of good, as in this instance it certainly is, for example, the preservation of life, although the course of nature be not completely adapted to it, or, to use the expression, although the course of nature be not such as that principle seems to indicate. The desire of ease, or of pleasure, sensual pleasure, to take a strong case, is probably original in the constitution of man; but it will be difficult to shew, that the course of nature is throughout friendly to its indulgence, or even to its exercise within such bounds as unguided reason would often sanction. This desire, however, we must, if we would be just, or even kind, to ourselves, many times quite overcome, and always moderate; and the giving way to it, though apparently natural, or, it may be, tolerated and reputable in society, might prove, as it often has proved, the source of the greatest wretchedness we can ever experience. Our conduct is virtuous or vitious, in reality, not so much as it proceeds from or opposes the original principles of our nature, but as it agrees or not with the circumstances and condition in which that nature is appointed to move. For example: On the supposition that our constitutions would certainly remain precisely the same as they now are, and would preserve their activity and power of enjoyment for a thousand years, in spite of all destroying or disturbing causes whatever, it might be advisable, at least it would not be irrational, to toil, as we see mankind generally do, for twenty or thirty years, in order, as it is usually said, to make a fortune, or to realize a competency for after life. The knowledge or perfect and correct conviction which the man had that he was to live so long afterwards, and to enjoy the fruits of his labour, might justify almost all his solicitude and his efforts for a portion of his time comparatively so small. But, in the absence of such assurance, nay, in the positive certainty that he cannot attain the tenth part of that space, and possess any thing like his present powers of action and enjoyment, and, farther, in the face of daily observation, that none of his fellow creatures has security for continuing a single hour in health or in life, such solicitude and toil, though perfectly natural, it may be, are inconsistent with the actual condition of mankind, and imply an amazing degree of presumption and folly. Every original principle of our nature, it seems, then, is not deserving of implicit and unqualified confidence.

We pass on now to the third general argument of the bishop.

" As 'tis evident," says he, " our *present* powers and capacities of reason, memory, and affection, do not depend upon our gross body in the manner in which perception by our organs of sense does, so they do not depend upon it at all in any such manner as to give ground to think that the dissolution of this body will be the destruction of these our present powers of reflection, as it will of our powers of sensation, or to give ground to conclude even that it will be so much as a suspension of the former." There is undoubtedly foundation for his remarks respecting the two states of life and perception of which we are susceptible, although it might be urged by an opponent, that the generality of mankind are rarely found in one of them, and that there are few, comparatively speaking, who attain the real dignity, while they enjoy all the possible happiness of human nature. Perfection of character, it may be mentioned incidentally, by no means consists, as some stoical and other mystical persons would have it supposed, in a total apathy and indifference towards every thing that is usually called sensual, or in a self-complacent and exclusive devotion of the mind to intellectual and religious objects. Whatever may be the nature and the consequent occupation of angelic beings, it is manifest that our species is not destined exclusively for such a state of abstraction. We are permitted and authorised to " use this world" so that we do not " abuse it," and it is allowed that we may exercise our powers, those which are common to us with the lower animals, not only innocently, but so as to glorify him by whom these powers are given expressly in order to promote our welfare in this very respect. This remark is made for the purpose of obviating a well meant, it is probable, but, however, an absurd objection.

The bishop proceeds to specify certain distinctions which he seems to hold as of great consequence to his argument. " Human creatures exist at present in two states of life and perception, greatly different from each other; each of which has its own peculiar laws, and its own peculiar enjoyments and sufferings. When any of our senses are affected, or appetites gratified with the objects of them, we may be said to exist or live in a state of sensation. When none of our senses are affected or appetites gratified, and yet we perceive, and reason and act, we may be said to exist or live in a state of reflection." The distinction is clear enough, and the language employed to express it is quite unexceptionable; but the reasoning founded on it is not altogether conclusive. "Now, it is by no means certain, that any thing which is dissolved by death is any way necessary to the living being in this state of reflection, after ideas are gained. For though, from our present constitution and condition of being, our external organs of sense are necessary for conveying our ideas to our reflecting powers, as carriages, and levers, and scaffolds are in architecture, yet, when these ideas are brought in, we are capable of reflecting in the most intense degree, and of enjoying the greatest pleasure and feeling the greatest pains by means of that reflection, without any assistance from our senses; and without any at all, which we know of, from that body which will be dissolved in death. It does not appear, then, that the relation of this gross body to the reflecting being is, in any degree, necessary to thinking; to our intellectual enjoyments or sufferings; nor, consequently, that the dissolution or alteration of the former by death will be the dissolution of those present powers which render us capable of this state of reflection." There is, it may be contended, an obvious *petitio principii* contained in this paragraph; and in answer to it, as well as to the hypothesis of which it is the basis, it is enough to remark, that so far as our observation and experience extend, there is ground to conclude, what the bishop seems unwilling to admit, that although our senses are not necessary for the exercise of our reflecting powers, when we have acquired the materials of thought, nevertheless, something of a material nature, and consequently, according to the principles of reasoning here recognized, liable to be dissolved by death, is requisite for the exercise of our reflecting powers. Without at all regarding a modern theory, if such it must be called, by which it is supposed possible to assign distinct faculties of the mind to peculiar portions of the brain, as the organs through or by means of which they operate and manifest themselves, it is commonly allowed, and seems unquestionable, that a certain state of the bodily frame, nay, a certain condition of the brain, is essential to their exercise. In opposition, then, to the bishop, his opponents might assert, that "the relation of this gross body to the reflecting being, is, in some or other degree, necessary to thinking, and to our intellectual enjoyments and sufferings;" and hence the probability remains, "that the dissolution or alienation of the former by death will be accompanied with the destruction of those present powers which render us capable of this state of reflection:" Or, to sum up the objection in other words, "we have reason to believe the exercise of our powers of reflection depends, as the existence of them does, on a part of our material system, in the same manner as sensation depends on our nervous system and its connection with the brain; and, in consequence, it is probable, our life of reflection will cease with our life of sensation, when these bodies are destroyed on which, in whole or in part, they depend." It may be said, besides, that the pleasure which the bishop asserts, and it is admited truly, may be enjoyed by means of reflection without the *continued* aid of our senses, implies, notwithstanding, the existence of a sentient being in which the agreeable feelings are excited; and the same thing may be predicated of other feelings, unpleasant ones, which are experienced at times from the exercise of reflection. Aware of this objection, it should seem, and knowing the impossibility of obviating it in a satisfactory manner on the ground assumed by him, all that the bishop affirms on this head is simply this,—"It is *by no means certain*, that any thing which is dissolved by death is any way necessary to the living being in this its state of reflection after ideas are gained." This may be readily granted, although there still remains a difficulty; namely, that our life of reflection is not only connected with our life of sensation, but seems also to obey the same laws, as to its origin, growth, and decay. It is admitted, on all hands, to be subsequent to sensation; the power of it is for a long time very inconsiderable in all persons, and in some it is scarcely ever discernible, although all the senses are exercised in full perfection: Farther, not to speak of the effect of diseases, however early it may exist, however greatly or long it may be exercised, certain it is, that, generally, after a particular period of life, not indeed the same in every individual, which makes no difference in the argument, this power is subject to decay, and to be lost, apparently in the same way as any other power of which our nature is possessed. Surely, then, there must arise, from such almost universal experience and observation, a presumption that this our life of reflection is not more durable than our life of sensation.

The judicious reader will perceive, by the issue of the examination in which we have thus been engaged, that arguments such as those of Bishop Butler, if advanced as direct proofs of the doctrine in question, and not, as used by him, simply in reply to objections against it, would be very inadequate grounds for so magnificent a superstructure, and, indeed, if alone confided in, there is reason to fear, as is well observed on another occasion by Bishop Horsley, that "such laborious demonstrations of the truths of natural and revealed religion have made more infidels than converts." It is a duty of sound philosophy, then, equally as of true piety, not to rely on them implicitly, but to regard them only as presumptive proofs, and to have recourse, amid the trials and afflictions of life, and in its last appalling hour, to the "glorious gospel of the blessed God," that "as sin hath reigned unto death, even so grace reigns through righteousness unto eternal life, by Jesus Christ our Lord." See Moral Philosophy.

MINDANAO. See Magindanao.

MINDEN, or Munden, a town of the kingdom of Hanover, situated on the river Weser, and defended with walls and ramparts. It is two miles in circuit, contains a fine cathedral and various churches, and carries on manufactures of wax candles, hats, leather, and soap, as well as sugar-refining and bleaching. Minden is a place peculiarly adapted for trade, and the possession of it has alternately been contended for by the Imperialists, Swedes, and French. A memorable conflict between the English and French took place here in 1759. The population is estimated at 7000.

MINE, a subterraneous excavation for working such minerals as generally lie in beds, such as coal or limestone; and likewise for working veins which contain the various ores of metal. The working of coal mines is amply described under Coaliery, and the natural history of the metallic ores is fully detailed in the article Geology.

The substances sought for in mines being different, the subterranean depositaries are known by various denominations, as gold, silver, copper, iron, or diamond mines, salt mines, mines of antimony, &c.; but when stone is the material, the mines are commonly styled quarries.

The internal parts of the earth consist of various strata, or beds, of substances extremely different from one another in their appearances, specific gravities, and chemical properties. In general, mines may be said to be certain fissures, or cavities under ground, filled with metallic or other valuable substances. The sides of these cavities, receding from, or approaching nearer to each other, make them of unequal breadths in different places, and sometimes form large spaces, which are denominated holes. The size of even the largest fissures is wonderfully small, compared with the bulk of the earth; yet in many cases immense caverns are formed by the removal of the mineral substances, as in the iron mines of Sweden, visited and admirably described by Dr Clarke. Whether large or small, the veins are denominated loads, or lodes, anciently and more properly, says Dr Johnson, *lode,* as derived from the Saxon word which signifies to lead, and having been primarily applied to the leading veins in a mine. When the substances found are reducible to metal, the lodes are by the miners said to be alive, otherwise they are called dead lodes. The insides of the fissures are commonly coated over with a hard, crystalline, or earthy substance, denominated the *capel,* or *wall* of the lode; but Mr Price, in his Treatise on the Cornish Mines, maintains that the proper walls of the lode are the sides of the fissure itself, the coat which frequently comes off with the ore being only the natural plaster of these walls, formed perhaps from the contents of these fissures, or the oozings of surrounding strata. The angle of inclination made by the fissures, at their beginning, in the solid strata, is usually kept all along in their course. Some are small at their upper part, and wide underneath, others invert this order. Their breadth as well as depth varies much; and a fissure which opens many fathoms at one place, shall a little further on be contracted to the size of an inch. Their length is in a great measure unlimited. They frequently pass through a vast extent of country with few variations in direction. Metallic veins, especially in Cornwall, generally run from E. to W. with slight declinations; but they are frequently intersected by veins, or lodes of other matters, which run from N. to S. In some mining fields, however, the most productive veins run from north to south. Some cross veins, according to Mr Price, contain lead or antimony, but never copper or tin.

When the true lode is intercepted by the crossing of a vein of earth or stone, or some different metallic substance, it generally happens that one part of the lode is removed to a considerable distance. The transient lode is by the miners called *flooking,* and the part of the true one which is moved, is said to be *heaved.* The intersection may be either at right angles or obliquely; but sometimes the mixture of both lodes is so intimate, that the most expert miners are at a loss to find the separated part of the true vein. When intercepted at right angles, it is moved a little to the N. or S. perhaps not above a fathom. In this case, having worked to a small distance in one of these directions, if they find themselves disappointed, they turn to the other hand, and seldom fail of meeting with what they expected. When the interruption happens in an oblique direction, the difficulty of finding the vein again is much greater. Besides the E. and W. direction, there is what the miners call the *underlying,* or *hade* of the vein or lode, that is, the deflection of the fissure from its perpendicular line as it is followed in depth, resembling the slope of the roof of a house. When a position almost horizontal is assumed, they are called *flat lodes,* or *lode plots.* When the fissure widens horizontally a little way, and then descends perpendicularly, alternating this appearance like stairs, with only a small string or leader to follow after, and yielding the ore chiefly in the horizontal position, that space is called, by the Cornish miners, a *floor* or *squat.* Veins crossing one another are sometimes met with; and these have been styled *contras,* vulgarly pronounced *caunters.* Sometimes, too, a vein suddenly disappears by becoming narrower, or of no value, which is called by the miners a *start* or *leap,* and is common in the mines of Cornwall.

Considering the difficulties attending the discovery of mines, it is wonderful how, before the nature and properties of metals were known, the idea of digging for them in the earth was suggested. Accident alone, however, has given rise to the dicovery of many mines. A tempestuous wind, by overturning parts of rocks, or tearing up trees, has not unfrequently discovered a mine; and the same fortunate result has been known to proceed from violent showers, thunder, earthquakes, the firing of woods, or even the stroke of a ploughshare or horse's hoof. By means of a torrent, a rich vein of the silver mine at Fribourg in Germany was originally laid open.

The scientific miner, in proceeding in search of such veins, ores, or sands as may be found worth working, is chiefly guided by his sagacity, or acquired habit, of inferring, from certain indications, that metallic substances are actually deposited in particular parts of the earth. Of these indications, the following are among the most important: 1. The discovery of certain mineral waters; 2. The discolouration of the plants or herbage of a place; 3. Pieces of ore on the surface of the ground: 4. The finding of metallic sands. In such situations as may be supposed to contain metals, it is usual to make search by boring into the earth. This process is conducted by means of an instrument called a borer, consisting of iron rods, which being drawn back at proper times, raise up samples of the different strata. (See Coaliery.) The ancient method of discovering veins, called *shoding,* though precarious and difficult, is sometimes adopted by the miners. When they observe loose stones, or fragments of rocks charged with metal, and which are termed shodes, they assiduously trace them, if possible, to the vein whence they have been detached, and, it is said, seldom fail in the attempt. Somewhat similar is the following manner of discovering silver, as mentioned by Alonzo Barba. "The veins of metal," he observes, "are sometimes found by great stones above ground; and, if the veins be covered, they hunt them out after this manner: Taking in their hands a sort of mattock, which has a steel point at one end to dig with, and a blunt head at the other, wherewith to break stones, they go to the hollows of the mountains where the current of rain-water descends, or to some other part of the skirts of the mountains, and there observe what stones they meet with, breaking in pieces those that seem to have any metal in them, whereof they find many times both middling sort of stones and small ones of metal. Then they consider the situation of that place, and whence these stones can fall, which, of necessity, must be from higher ground, and follow the tract of them up the hill, as long as they can find any of them." The methods now most generally adopted for the discovery of mines, are the two following:—Either removing the soil from the surface of the rock, and thus bringing to view the back of the vein, or driving under ground levels, or horizontal cuts, which, in their progress through the rock, or, as the miners say, across the country, effectually intersect and expose lodes. Mr Price, in speaking of working drifts from north to south, and *vice versa*, says, "I tried the experiment in an adventure under my management, where I drove all open at grass about two feet in the shelf, very much like a level to convey water upon a mill-wheel. By doing so, I was sure of cutting all lodes in my way, as they run from east to west, and did accordingly discover five courses, one of which yielded above 180 tons of copper ore. This method is equally cheap and certain, for 100 fathoms in shallow ground may be driven at L.2, 10s. expence."

A mine being found, the first business is to determine whether it may be worked with advantage. The nature of the place must be considered—its situation with regard to wood, water, convenience for carriage, and the like; and the result compared with the quality of the ore, and the charges of digging and smelting. Of the three situations in which a mine may be found,—elevated ground, a valley, or a flat—the first is evidently the most favourable, as affording the greatest facilities for the adits or avenues, that is, drains or burrows, for carrying off the water, and forming gang-ways whereby to bring out the metal. It is desirable, if possible, to trace out a vein that has been exposed by a torrent, or other incidental cause; and, on discovering such, the mine may be advantageously opened at that place, more especially if the vein promise well in richness and extent. Experience proves that neither on a flat nor on the summits of mountains, but on the sides, may be chosen the most convenient situation for commencing the necessary operations; and the most eligible spot is a mountainous, wholesome, and woody one, of easy ascent, and not far from a navigable river. But, indeed, the places where mines abound generally stand high, and are therefore most commonly wholesome, though some occur which, from their unhealthy tendency, cannot be wrought.

In forming a judgment of the proper value of a lode, the most decisive indications are, the nature of the substances contained in the vein, the kind of rock in which it is found, the width and regularity of the vein, or its structure. As veins rarely contain ore near the surface of the ground, the miner must of necessity be qualified to judge, from particular signs, how far he may be justifiable in proceeding on farther trial, and to acertain what may be the amount of risk in so doing. According to the depth to which the lode is penetrated, the substances of the vein are found to vary. Tin and lead always lie nearer the surface than copper, and it must be remembered that the finding of rich bunches of the latter is not to be depended on as a positive indication of success, such deposits being not unfrequently followed by poverty at a greater depth. When a lode is hard, and in other respects seemingly unfavourable, small strings of ore do not warrant expensive trial; but when, together with other promising indications, a lode is found spotted with small portions of ore, there is a strong presumption of a rich product being obtained. In judging of the general appearance of a lode, the other important circumstances to be kept in view are, the width and regularity of the vein, and its direction and dip. Considerable deposits of metal are not to be expected if the lode be small; but a large and productive lode is usually accompanied by other veins, which run parallel to it or nearly so, and frequently fall into the main lode. That the direction should be well known, appears from the circumstance, that particular ores are found only in such veins as have their course in common with others in the district containing the same deposits. It is worthy of remark, that the abundance of water in a lode is commonly viewed as a promising indication, it being found that dry veins are never very productive. The mines of Cornwall and Devon abound with water, as is manifest from the great number of overshot water-wheels and of steam-engines employed in draining them.

When two metallic veins, near each other, run in an oblique direction and meet, they produce a good body of ore at the place of intersection, especially if both are rich. After continuing together for some space, more or less, they usually separate again, and each will continue its former direction. Sometimes, but rarely, they continue united. If the branches under, lie faster than the true vein, that is, dip deeper, they are then said to overtake or come into the lode, and to enrich it; if the contrary be the case, they are said to go off from and impoverish it. Neither these, however, nor any other marks of the richness or poverty of a mine, are entirely to be depended upon; for many mines which have a bad appearance at first, turn out extremely well, while others that seemed rich become gradually worse.—But in general, unless the appearance be good at first, it will be imprudent to be at much expense. However narrow, if there be a string of good ore, it will generally be worth while to pursue it. It is an encouragement to go on if the leaders enlarge in width or depth, as they are worked; but it is a bad sign if they continue horizontal without inclining downwards. The fissures most common in Britain are the perpendicular and inclined, whatever their direction be. Veins of tin are worth working when only three inches wide, provided the ore be good, and copper ores when six inches wide generally pay well. Some of the great mines, however, have very large veins, with a number of smaller ones near each other. The richest state for copper, according to Mr Price, is from 40 to 80 fathoms deep, for tin from 20 to 60: and though a great quantity of either ore may be raised at 80 or 100 fathoms, yet the quality is often too much decayed and dry for metal.

According to Dr Nichols' observations on mines, they seem to be, or to have been, the channels through which water passes within the earth, and, like rivers, accordingly have their small branches opening into them in all directions. Most mines have streams of water running through them; and, when dry, it seems owing to the waters having changed their course, or having been compelled to do so by the lode stopping it up.

Extensive mines, like those now mentioned, are usually worked by a company of proprietors or adventurers, who agree with the lord of the soil, as he is commonly termed, to pay, by way of rent, a certain proportion of the ores raised, and thus to work the mine for a stipulated period of years. In Cornwall, especially, the working of the tin mines, which constitute the mineral treasures of that county, is in this way carried on with regularity. Each mine or piece of ground, where ore is sought for, belongs to one or more proprietors, and the ore, as it is brought up, is divided into shares, according to the number of these. The several shares are beaten small in a stamping mill and washed, as already described in the article Metallurgy. The metal is then fused and cast into blocks of 200 or 300 lbs. weight, which blocks are four times a-year carried to the nearest of five towns appointed for that purpose, to be stamped. The whole annual produce of these mines is 25,000 or 30,000 blocks, and of each block of 320 lbs. weight the value is estimated at L.10 Sterling. The copper ores in Cornwall and Devon are, when prepared for sale, sampled by proper agents, and are sold on a particular day, when they are weighed previous to their being shipped for Wales, where the copper smelting-houses in general are situated.

Notwithstanding the many contingencies to which mines are liable, instances are not wanting of their continuing for hundreds of years to prove highly productive. Thus the mines of Potosi are, with great success, worked to the present time; the gold and silver mines of Cremnitz have been worked for nearly three thousand years, and the mines of Cornwall are of great antiquity. It is calculated, that the silver alone dug in the mines of Misnia in Saxony still yields, in the course of eight years, a nett profit of one thousand six hundred and forty-four millions, besides seventy-three tons of gold.

**MINE**, in Fortification. See War.

**MINEHEAD**, a maritime town of Somersetshire, situated near Dunster castle, and having a harbour in the Bristol channel. It formerly enjoyed very considerable trade, particularly in herrings, which were sent to the Mediterranean and other quarters. Woollen cloths now constitute the chief manufacture: and a weekly market is held on Wednesdays.

**MINERALS**, or Fossils. See *Mineralogy* under Geology.

**MINERAL Waters**, a term applied to such waters as are impregnated with sulphureous, metallic, saline, or other matter, and are denominated according to their peculiar ingredients. Mineral waters are perceptibly distinguished by the taste, smell, or colour from pure water. See Chemistry.

**MINERALOGY.** See Geology.

**MINERVA**, Athena, or Pallas, in heathen mythology, the goddess of wisdom, arts, and war, and said to have sprung, completely armed, from Jupiter's brain. She contended with Neptune for the privilege of giving a name to the celebrated capital of Cecropia, it being agreed that whoever of them should produce what was most useful for mankind should have that honour. With a stroke of his trident Neptune produced a horse, but Minerva produced an olive plant, which, from its being the symbol of peace, was, by the unanimous consent of the gods, adjudged to be most valuable, upon which she called the city Athenæ after herself, and became its tutelar goddess. Various other exploits are attributed to Minerva, and numerous temples were erected to her both in Greece and Italy: but the most magnificent was that at Athens, where likewise a splendid feast, called Atheneia, was observed in honour of her. Minerva is commonly represented with a placid and agreeable countenance, bearing a golden breast-plate, a spear in her right hand, and her ægis or shield in the left. Her helmet is entwined with olives, and on her ægis is a representation of Medusa's head encircled with snakes. The cock, the owl, and the basilisk were sacred to her, and the usual victim offered to her was a white heifer that had never been yoked.

**MINGRELIA**, a province of Turkey, already alluded to under Colchis. It is a woody country; and the chief food of the inhabitants is a sort of grain resembling millet, wheaten bread being only used by the prince and nobility. The chase constitutes the principal occupation of the natives. Cotatis, or Cutais, is the principal place, and contains nearly 200 houses. The commerce of Mingrelia consists in slaves. In ancient times it was rich and fruitful, abounding in all the necessaries of life, and had many mines of gold, from which originated the fable of the Golden Fleece, and the celebrated Argonautic expedition.

**MINISTER**, in Scotland, a person whose duty it is to perform religious worship in public, by preaching, administering the sacraments, &c. A minister of state is one entrusted with the administration of government, and having other persons connected with him in the executive power, who are also denominated ministers. Foreign ministers are persons appointed in foreign countries to manage the affairs of the state to which they belong. These are of two kinds, namely, ambassadors and envoys extraordinary, who represent the persons of their sovereigns, and ministers of the secondary rank, who are ordinary residents.

**MINOR**, in law, is a person under age, and consequently unqualified to take the management of his own affairs. In England, a person continues in a state of minority till he arrives at the age of twenty-one years. According to common law, the king has no minority, nor any legal guardian, and his grants and assents to acts of Parliament are perfectly valid though he has not attained the age of twenty-one. No person can sit or vote in either house of Parliament till he be twenty-one years of age.

MINORCA, an island of the Mediterranean, situated 50 miles north-east from Majorca, is 34 miles in length and 12 in breadth, and divided into four districts called *Terminos.* It consists of the termino of *Ciudadella*, once the capital, but now reduced to about 600 houses, a cathedral, several churches and convents, and a convenient harbour; the termino of *Fererias* which is united to *Mercandal*; that of *Alayor*, with the capital of the same name; and the termino of *Mahon*, now the most considerable, (containing nearly one half of all the inhabitants of the island,) so named from Mago, the Carthaginian general, who is supposed to have founded it. The town of Mahon occupies an elevated situation, and contains a number of public buildings, the principal of which are the governor's palace and a spacious church. The port, which is the finest in the Mediterranean, is well defended by the strong fort of St Philip, and is furnished with a most commodious quay, the extremity of which is reserved for ships of war.

This island enjoys a salubrious climate, but is liable to storms of wind from the north-east, which prove injurious to the crops. The vineyards are numerous and very productive, and wheat, barley, maize, and vegetables of all kinds, are abundant. The imports into Minorca are of considerable magnitude, but comparatively little is done in the way of exportation. Among the principal imports are corn, cattle, sheep, fowls, tobacco, rice, oil, sugar, spices, hardware, earthenware, and various other articles.

The natives of Minorca are a well formed, robust race, of middle stature; very choleric, but generally temperate in their habits, except on festivals or any extraordinary occasions, when they are addicted to almost incredible extravagance. Their food consists chiefly of flour-bread, together with rice, pulse, herbs, fruits, pickled olives, and pods of the Guinea pepper.

Vestiges of the Romans and Moors are still visible in Minorca. A huge mass of unhewn stones in the district of Alayor is supposed to be of Druidical origin, and is called the Altar of the Gentiles; and the remains of a fortification on the summit of mount St Agatha is attributed to the Romans.

This island was long possessed by the Romans, who called it *Baleares*, in allusion to the dexterity of the inhabitants in using the sling. Having fallen into the hands of the Arabs, it was wrested from them by the king of Majorca, by whom again it was surrendered to Spain; and it has been since possessed alternately by the English, French, and Spaniards.

MINOS, in mythology, the son of Jupiter and Europa, and king of Crete, who, on account of his superior wisdom as a legislator, is fabled to have obtained the dignity of judge in the invisible world. Minos flourished 1432 years before the Christian era. He feigned that the laws he inculcated were dictated to him by Jupiter, in a cave to which he was accustomed to retire. About 1000 years after his death his laws are said to have continued in full force. This extraordinary legislator, denominated the favourite of the gods and the confidant of Jupiter, is represented as judge of the infernal regions, with a sceptre in his hand. In the capacity of an impartial judge of the dead, he shakes the fatal urn fraught with the destinies of mankind.

MINOTAUR, a monster, fabled by the poets to be half a man and half a bull. It was the offspring of Pasiphae, wife of Minos II. king of Crete, and being confined in the labyrinth, it there devoured the young men and maidens annually exacted from the Athenians. See ARIADNE. By way of accounting for the fable of the Minotaur, it has been supposed that Pasiphae was enamoured of the courtier Taurus, and that these lovers having been favoured with a retreat in the house of Dædalus, Pasiphae ultimately brought forth twins, one of whom resembled Minos and the other Taurus.

MINSTER, from the Saxon *mynster* or *mynstre*, was anciently the denomination of the church of a monastery or convent.

MINSTREL, from the French *menestrier*, is an ancient term denoting a vocal or instrumental performer. These performers were the immediate successors of the bards, and are said to have been accomplished in music, poetry, and dancing. They were greatly venerated by the Saxons and ancient Danes. Owing to the gradual diffusion of knowledge among the former, however, their skill ceased to be viewed as supernatural, and the poet and minstrel became distinct individuals. The minstrels still continued to obtain countenance and support, by harping at the houses of the great, till, in the time of Queen Elizabeth, a statute was enacted, classifying them among "rogues, vagabonds, and sturdy beggars." It is probable that most of the heroic ballads were composed by the minstrels. See BARD.

MINT, signifies the place where the king's money is coined. In ancient times, mints were established in almost every county of England. It was enacted by Athelstan, in 928, that only one sort of coin should be current, and a proportionate number of moneyers were appointed to different towns, according to their size. Material improvements in this department were effected by Edward II.; and these continued in force till 1608, when the establishment came under the cognizance of a select committee, the result of whose deliberations was the erection of the new mint on Tower Hill, between the years 1805 and 1810. The principal officers connected with his Majesty's mint are:

1. The warden, who is the chief, and who oversees the other officers, and receives the bullion. 2. The master-worker, who receives the bullion from the warden, causes it to be melted, delivers it to the moneyers, and when coined receives it again. 3. The comptroller, who being overseer of all the inferior officers, sees that all the money is made to the just assize. 4. The assay-master, who weighs the gold and silver, and ascertains that it is according to the

standard. 5. The two auditors, who take the accounts. 6. The surveyor of the melting, who, after the bullion has been assayed, sees that it is cast out, and not altered after it has been delivered to the melter. 7. The chief engraver, who prepares the stamps and dies for the coinage. 8. The clerk of the irons, who superintends the machinery. 9. The melter, who melts the bullion before it be coined. 10. The provost of the mint, who oversees and provides for all the moneyers. 11. The blanchers, who anneal and cleanse the money. 12. The moneyers, some of whom forge the money, some share it, some round and mill it, and some stamp and coin it. 13. The porters, who keep the gate; solicitor of the mint, &c. For a description of the process of coining, and of the machinery employed, see Coining.

MINUTE, in astronomy and geography, signifies the sixtieth part of a degree. All circles are supposed to be divided into 360 degrees, each degree into 60 minutes, each minute into 60 seconds, &c. A degree is marked by a small ° over the top, minutes are expressed by a dash′, seconds by two dashes″, the third by three dashes‴; thus, 5 degrees, 3 minutes, 4 seconds, 2 thirds, are marked thus, $5^\circ$, $3'$, $4''$, $2'''$. In chronology, the term minute denotes the sixtieth part of an hour; and in architecture it is the sixtieth part of a module, though sometimes reckoned as the thirtieth part.

MIRACLE, a term derived from the Latin, and properly signifying something *wonderful.* In philosophy it is employed to denote an effect produced by a cause *superior* to the established laws of nature. This cause must be conceived not only as operating independent of the laws of nature, but as having power to modify, control, counteract, or suspend these laws. In every instance of miraculous interference, divine power is exerted according to the nature of the miracle to be performed. The laws of nature may be suspended, as when the sun seemed to stand still, or the diurnal rotation of the earth to be arrested at the command of Joshua; or they may be counteracted, as when the shadow went back on the dial of Ahaz, or when iron of a certain mass was made to swim; or the effect may be produced independent of them, as when the hand-writing appeared on the wall. In the case of some miracles, creating power appears to be exerted in accomplishing the end designed, as in the instance of the loaves and fishes. In regard to the effect, it must be sensible, and so decidedly supernatural as to be inexplicable on the principles according to which the usual course of nature proceeds, so as to preclude all suspicion of deception or collusion. When a human being is the subject of a miracle, whether the miraculous power be exerted upon his mind or his body, the effect must not only be felt by him on whom the miracle is wrought, but must be an object of sense to those who are the witnesses of the miracle; and that no room may be left for trick of any kind, it must be open for investigation or inspection. Most miracles are of a transient nature. There are, however, some which, from being permanent in their effects, have been denominated standing miracles.

As miracles are, in any or all of the views just stated, a deviation from the ordinary laws of nature, they can only be occasional; but while it is admitted that such occasional interference is clearly within the compass of divine power, the object to be gained must be as clearly sufficient to justify it; since otherwise an imputation would be thrown on the divine wisdom. We can never believe that God would resort to miracles merely for the purpose of displaying his power, far less for gratifying human curiosity. Something must be proposed which could not have otherwise been accomplished, and so great as to render such extraordinary interference worthy of the Deity. The object of a miracle may be either the demonstration of a particular providence, or a proof of the perpetual dependence of the laws of nature on God, as the great first cause, if this has become liable to doubt or denial, but more especially the accrediting of a revelation from Heaven, designed to influence the present moral condition of man, and to establish his hopes for eternity.

That miracles, as now described, furnish proper and conclusive proof of a divine revelation, must be sufficiently obvious from the nature of the works. This was, indeed, early admitted by the common sense of mankind. The sentiment stated by Nicodemus is recognised as true by every reflecting mind, that no man can perform a real miracle except "God be with him." The only qualification that ever was proposed with regard to miracles, was what reason itself justly demanded, namely, that the system which the miracle appeared to support should not be at variance with the doctrines of natural religion. If the miracle appear in any way to be contrary to right reason, it must either be a "lying wonder," a mere imposition, or, if real, must be regarded as an extraordinary occurrence which God has permitted, solely for the purpose of putting men to the test whether they will abide by the dictates of reason, or suffer themselves to be seduced from principles already fully established. "If there arise among you a prophet, or a dreamer of dreams, and giveth thee a sign or wonder; and if the sign or wonder come to pass whereof he spake to thee, saying, let us go after other gods, and let us serve them; thou shalt not hearken to the words of that prophet, for the Lord your God proveth you, to know whether you will love Jehovah your God with all your heart, and with all your soul."—Deut. xiii. 1-3. The criterion suggested in these words only shows us how fearless the sacred writers were of detection. It cannot affect the revelation contained in the Scriptures; for revelation confessedly recognises, sanctions, and, in fact, rests upon the pure doctrines of natural religion relative to the unity, perfections, and government of the Deity; and though it contains many things above the ken of human intellect, yet none of all these has ever been proved to be contrary to right reason, or other than might be expected in such a supernatural disclosure. The fair conclusion, from the qualification now stated, is simply, that the *internal* should be taken in connection with the *external* evidences of any revelation professing to come from heaven; and to this rule Christians have ever been willing to submit the principles of their belief.

Miracles are capable of being fully proved by *testimony*. Infidels while they admit that such works, if they have been really performed, must be a sufficient attestation of divine commisssion, attempt to set aside the force of the miracles recorded in Scripture, in one or other of the three following ways: By ascribing them to magic; by parallelizing them with others said to have been wrought in favour of heathenism; or by altogether denying them. While the works were performing or recent, and could not be denied, they were ascribed by some to infernal agency. The Pharisees alleged that our Lord cast out devils by Beelzebub, the prince of devils; an idea sufficiently refuted by the question, "Is Satan divided against himself?" Afterwards, while the works were still recent, no attempt was made to deny them; but the plan followed by the Pagan philosophers was to compare them with others said to have been wrought under the auspices of the heathen gods. But these last, being adduced in support of a system contrary to reason, are discarded on the principle already stated, as either lying wonders or strong delusions, to which God judicially gave up those who renounced the doctrines even of natural religion. It is only in modern times that attempts have been made to deny the miracles recorded in Scripture, upon the pretence that such works cannot be ascertained by testimony. We, says the infidel, must believe nothing that does not agree with our own experience; and as miraculous works are what we never either saw or felt, they are entirely out of the sphere of observation, and even of ordinary occurrence. But was not this to be expected? How can miracles ever be common or of universal occurrence? Would they not then cease to be miracles, and thus fail to answer the purpose of a special attestation? From the nature and tendency of miracles they must have occurred but seldom, and only in some places of the world. If they were designed to be of real benefit to mankind in general, (and we can hardly suppose them to have taken place for any other purpose,) their utility must depend upon testimony or authentic record. Now, since miracles are facts, they are as capable of being ascertained by credible testimony as any other facts. The rule, that nothing ought to be admitted but what *coincides* with our own experience, would invalidate to a great extent the faith of all history, and limit our knowledge to a very small compass indeed: Nay, it is false; for upon the same principle the inhabitants of certain places in the tropical regions might deny that ever any such thing as snow or ice existed, and would be fully justified in rejecting all testimony on the subject. If the rule be modified by saying, we must admit nothing which is *contrary* not merely to our own experience but likewise to that of the rest of mankind, this modification, which might seem to render the principle unexceptionable, will be found to be of the most dangerous tendency, ultimately befriending even atheism itself; for since creative power has now no place of operation in the material world, to suppose its operation at any given time must be contrary to the experience of mankind; and therefore, by such a rule, the material system must have been eternal.

Hume, in his Essay on Miracles, has endeavoured to prove that miracles are not capable of being established by testimony. "No testimony," says he "is sufficient to establish a miracle, unless the testimony be of such a kind that its falsehood would be more miraculous than the fact which it endeavours to establish. When any one tells me that he saw a dead man restored to life, I immediately consider with myself, whether it be more probable that the person should either deceive or be deceived, or that the fact he relates should really have happened. I weigh the one miracle against the other, and, according to the superiority which I discover, I pronounce my decision, and always reject the greater miracle." The evidence of testimony, he adds, when applied to a miracle, is a subject rather of derision than of sound argument; because it carries falsehood on the face of it.

In refutation of this specious argument, Dr Campbell, in his Dissertation on Miracles, very properly observes, that testimony is the sole foundation of the greater part of what has been termed by Mr Hume unalterable experience; and that if we did not in some particular cases render an implicit faith to testimony, our knowledge would be confined to the events which come under our own immediate observation, and that, antecedent to experience, testimony has a natural influence on belief. In like manner, Dr Adams, in his Essays on Miracles, ably refutes the principle laid down by Mr Hume. "Our own experience," he observes, "reaches around and goes back but a little way; but the experience of others, on which we chiefly depend, is derived to us wholly from testimony." If this be the case, as undoubtedly it is, the evidence of testimony must be of less force according as we weaken that of experience. Dr Paley has to the same purpose adopted a train of reasoning that cannot be resisted. "If twelve men," says he, "whose probity and good sense I had long known, should seriously and circumstantially relate to me an account of a miracle wrought before their eyes, and in which it was impossible that they could be deceived; if the governor of the country, hearing a rumour of this account, should call these men into his presence, and offer them a short proposal either to confess the imposture, or submit to be tied up to a gibbet; if they should refuse with one voice to acknowledge that there existed any falsehood or imposture in the case; if this threat were communicated to them separately, yet with no different effect; if it was at last executed: If I myself saw them one after another consenting to be racked, burnt, or strangled, rather than give up the truth of this account,—still, if Mr Hume's rule be my guide, I am not to believe them. Now, I undertake to say, that there exists not a sceptic in the world who would not believe them, or who would defend such incredulity."

From what has now been advanced, it may be inferred that if the testimony of the first propagators of Christianity be true, the miracles which the gospel records have to a certainty been performed, and therefore the doctrines of the gospel must be a divine revelation. Nay the fact appears undeniable, that we have *the most credible testimony* relative to all the miracles recorded in Scripture, particularly of those wrought in comfirmation of the doctrines and precepts of the New Testament. It is perhaps altogether unnecessary to go beyond the volume of Scripture for confirmation on this point, though many tesmonies from heathen authors might easily be adduced; nor, in appealing to Scripture, is it necessary to assume that the record is divine. Let the Bible only be placed, in the first instance, on a level with human records; it contains the most satisfactory evidence to the truth of these wonderful works. (1.) The witnesses were many, and they appealed to others who had either seen or been the subjects of the miracles performed. (2.) They are wholly unexceptionable. They could not themselves be deceived, for they had the best opportunities of ascertaining the facts, which were frequent, and familiar to them, coming almost constantly under their own observation; and they themselves were not predisposed to believe them. They had no temptation to deceive others, but the contrary, whether we think of temporal inducements, seeing their testimony exposed them to reproach and persecutions, or of spiritual expectations; for if the whole was a fable, where could be their hopes of heaven or of any compensation in another state, to recompense them for their sufferings on earth. So fully satisfied were they of the truth of their testimony, that many of them sealed it with their blood. They were men, too, of approved integrity and pure morality, the very teachers of the most rigid system of morals that ever was given to the world. They wrote while the facts which they affirmed were recent, and that too without fear of being contradicted; a risk to which, even as men of common sense, they would not have exposed themselves if conscious that no such works had been performed. In addition to these prepositions, it may be observed, that the chosen witnesses themselves wrought miracles, and displayed powers which furnished more than human credit to their testimony. Of their supernatural gifts we have monuments to this day, in the very books which they wrote; for the writers, with one exception, were Jews, and yet their books were written in Greek; though, with perhaps two exceptions, they were illiterate men, who of themselves could have no such facility in literary composition as their writings display. (3.). The effect of the miracles also ascertains their truth. Would the Jews, whose obstinate character is in the sacred writings so faithfully portrayed, have adhered to a ceremonial so burdensome as that of Moses, if they had not witnessed the signs which attested their great legislator, and been fully satisfied as to the truth of the miracles he is said to have performed? And had not those by which Jesus was attested been true, would any of that nation have renounced their prejudices to cleave to such a person as he appeared to be, or adopt his spiritual system of religion? How, but on the supposition that, to their minds, the evidence seemed completely conclusive, shall we account either for the existence of the Christian system, or for its great success, both among the Jews and also among the Gentiles, in the most learned and civilized parts of the world?

Miracles, it may be observed, are neither the effects of natural causes, nor of superior created beings acting for themselves alone; nor have they been performed but either immediately by God himself, or by such beings as are empowered by him. From the account which the sacred writings afford of good and bad angels, of the devil, and likewise of the souls of departed men, and of the gods of the heathen, it is altogether inconsistent with their nature that they should possess a power of working miracles. It has indeed been disputed by some, how far the devil can have the power of working miracles, or wherein lies the difference between the miracles of Moses and those of the magicians, and between those of Jesus Christ and the Apostles and such as were wrought by Simon Magus and Appollonius Tyaneus; and whether they were only mere delusions of the senses, or whether any supernatural or diabolical power concurred in the performance of them? Farmer has shewn, that all the magicians, diviners, and sorcerers of antiquity, who pretended to foretel future events and to work miracles, are, in the sacred writings, branded as mere impostors, incapable of any prophecies or works beyond those of human power and art. The sacred writings, indeed, in effect, deny that any miracles can be performed either in opposition to the Deity or without his commission or immediate interposition. In reply to the objections brought forward respecting the Egyptian magicians, and the appearance of Samuel after his death, to Saul, which was either a divine miracle or the effect of human imposture,—respecting our Saviour's temptation in the wilderness, which has been considered by the above writer as a divine vision,—he likewise shews that no instance is any where recorded in Scripture of real miracles performed by the power of the devil; and that the divinity of all our Saviour's miracles, recorded in the New Testament, is either expressly asserted or clearly implied.

Miracles are regarded by theologians as a species of works adapted to other purposes besides the establishment of the divine origin of the Christian religion. Those of our Saviour were obviously designed not only to attest the truth of his mission in common with that of other extraordinary teachers, but also to demonstrate the high dignity of his character as the promised Messiah; to illustrate the benignant work which he came to accomplish by the gospel, in enlightening the minds and restoring the moral capacities of men; to display his control over nature and providence; and to set an example of benevolence to all his followers.

The precise period at which miracles ceased has not been ascertained. The most rational opinion is, that as they were designed to confirm revelation in general, they would not be continued for the purpose of settling controversies with regard to its contents. The canon of Scripture being completed, and its divine origin fully established, it became the standard of truth: and the province of reason is, first to ascertain its meaning, and then to submit to its dictates. Accordingly, neither Protestants nor Roman Catholics, nor, indeed, any of the sects into which Christians have unhappily been divided, are entitled to appeal to miracles in support of their respective systems of belief.

The reader, who wishes to prosecute this subject, may consult the Apologies of *Justin Martyr* and *Tertullian,* the writings of *Origen,* and other primitive fathers. The *Opuscula Werenfelsii,* highly esteemed by the late Principal Robertson, contain an admirable dissertation on Miracles, written in elegant Latin, and worthy of a high place among the more modern defences of our holy religion. The subject is excellently discussed by Paley; by Farmer, who enters very fully and successfully into the subject; and by Campbell, who combats the sophisms of Hume. An excellent, though but summary view, is given in Beattie's *Evidences*; and many powerful arguments are suggested on the same subject in some lighter productions, particularly the replies by Scott, Tytler, Thomson, and Bp. Watson, to the infamous Paine.

MIRROR, a polished body, which, by reflecting the rays of light, exhibits the image of any object placed in a proper position. Mirrors are plane, convex, or concave. The first represent bodies of their natural magnitude, by reflecting the rays of light as they fall on them; the second diminish the object, by making the rays diverge; the last, which magnify the object, by collecting the rays into a focus, are denominated burning mirrors.

Mirrors may be formed of glass, metal, or any substance capable of acquiring a sufficient polish, but that does not absorb too great a portion of light. From a passage in the Pentateuch, it appears that the Israelitish women used mirrors of brass, the art of making which, it is more than probable, was acquired from the Egyptians. Metallic mirrors for reflecting telescopes are considered superior to glass mirrors coated on the back with quicksilver; but glass is by far the best adapted for burning-mirrors. See OPTICS.

MISADVENTURE, in law, implies, in a special sense, the killing of a person, partly by negligence, and partly by accident. See HOMICIDE.

MISCHNA, or MISNA, the first part of the Jewish Talmud, containing the text to which the Gemara, or second part, is a kind of glossary. The Mischna consists of Jewish traditions and expositions of different passages of Scripture. The traditions, which are viewed as a supplement or explication of the written law, are supposed to have been delivered to Moses when he abode on the mount, and from him to have been communicated to Aaron, Eleazar, and Joshua. Learned men are not decidedly agreed as to the exact period at which the Mischna was written. See TALMUD.

MISDEMEANOUR, in law, simply denotes a crime; but as crimes are distinguished as of a higher or lower degree, the former are denominated felonies, the latter misdemeanours. "A crime or misdemeanour," says Blackstone, "is an act committed or omitted in violation of a public law either forbidding or commanding it."

MISERICORDIA, in law, an arbitrary fine imposed for some offence, and so called because the amercement ought to be less than that required by Magna Charta. The writ called *Moderata Misericordia* lies for moderating the fine according to the nature of the fault, in case a person be wrongously amerced in a court that is not of record.

MISFEASANCE, in law, signifies a trespass.

MISNOMER, in law, a mistaking the name of a person, especially his Christian name. The law is less strict respecting surnames; but a misnomer of the Christian name affords one of the principal pleas in abatement.

MISPRISION, from the French *mespris,* in a general sense, implies some neglect or oversight, and denotes all such high offences as are less but very nearly approaching to capital. A misprision is said to be contained in every treason and felony whatsoever; but the offender may, according to the king's pleasure, be proceeded against for the misprision only. Misprisions are of two sorts, negative and positive. The former, which is called misprision of treason, consists merely in the knowledge and concealment of treason, but becomes criminal if the first opportunity be not taken to reveal the same to a judge of assize or justice of the peace. By stat. Westm. 1. 3 Edw. I. c. 9. misprision of felony, or the concealment of a felony which a man knows, is punishable by confinement for a year and a day. Misprisions, termed positive, are a contempt of law, or high misdemeanours, such as mal-administration in the highest offices of the state. This is generally punished by the method of parliamentary impeachment. See Blackstone's *Commentaries.*

MISSAL, from the Latin *missa,* signifies the Romish mass-book, which comprises the several masses for all particular days. In the ancient church the term *missa* was expressive of every part of divine service, and every diocese and religious order had its particular missal accommodated to its festivals.

# MISSIONS.

THE diffusion of the gospel is so intimately connected with the highest and most lasting interests of our race, that every philanthropic mind must contemplate with pleasure the meritorious exertions of those who have devoted themselves to a task so arduous and important. To every thinking being, indeed, the gradual progress of Christianity, from its first introduction by the Messiah down to the present time, and which may not improperly be considered a series of missionary labours, constitutes a subject of momentous inquiry. But comparatively few of those missions which preceded the reformation afford any thing like a pleasing retrospect; though it must be admitted, that, to the exertions of Roman Catholic missionaries, our own country was in the sixth century indebted for the light of Christianity. In this article, therefore, we shall merely confine ourselves to a brief detail of the more remarkable attempts made by Protestants to propagate the principles of true religion among heathen nations.

It is a gratifying consideration, that, in communicating the knowledge of divine truth both at home and abroad, Christians of every denomination are most cordially united. "There are," says an amiable writer, "institutions which bear the genuine stamp of Christianity, not originating in party, founded on disinterestedness, and comprehending the best interests of almost the whole habitable globe,—without partiality and without hypocrisy." The following are the principal institutions for the support of Protestant missions among the heathen:

The Corporation for the Propagation of the Gospel in New England and the adjacent parts of America, erected 1649.
The Society (in London) for promoting Christian Knowledge, instituted 1698.
The Society for the Propagation of the Gospel in Foreign Parts, incorporated 1701.
The Society in Scotland for Propagating Christian Knowledge, incorporated 1709.
The Royal Danish Mission College.
The Moravian, or United Brethren, 1732.
The Methodist Missionary Society, 1786.
The Baptist Missionary Society, 1792.
The London Missionary Society, 1795.
The Edinburgh (now the Scottish) Missionary Society, 1796.
The Church of England Missionary Society, 1799.
The African Institution for Civilizing Africa and Educating the Native Youth, 1806.
The Baptist American Board of Commissioners for Foreign Missions, 1814.
The United Missions, United States, 1817.
The American Board of Commissioners for Foreign Missions, 1820.

The number of missionaries employed and supported by these associations is supposed to amount to about five hundred.

The light of Christianity, which, in consequence of the reformation in the sixteenth century, began to shine upon the benighted nations of Europe, evidently contributed, in an eminent degree, to soften and civilize the manners of many nations who, till then, were in a state of savage stupidity; though it is true other circumstances, not immediately connected with religion, likewise tended to promote the same happy effect. While the main object of the reformers was the propagation of the truths of divine revelation in the different countries of Europe, the conversion of the heathen in the more distant parts of the globe was also an object of their laudable ambition. Arrangements were made at Geneva, so early as the year 1556, to introduce the Christian faith into the extensive regions of America: and not many years afterwards a settlement was attempted on the coast of Brazil, which, however, did not succeed.

### *Missions in Europe.*

*Lapland.*—Some ages prior to the reformation, Christianity had been introduced into Lapland, though that country was afterwards reduced to a deplorable state of Paganism in 1539, at which period a missionary was sent to it by the celebrated Gustavus Vasa, king of Sweden. Since that time considerable exertions have been made to advance Christianity among the Laplanders by the establishment of schools, and also by furnishing them with the New Testament translated into their own language. But it is much to be regretted that from these exertions little real good has resulted; for while many of the people affect to believe the docrines of true religion, such is their ignorance and superstition, that they may be said scarcely to maintain even the name of Christians.

### *Missions in Asia.*

*Tartary.*—In 1802 the attention of the Edinburgh Missionary Society being directed to those countries bordering on the Black and the Caspian seas, the Rev. Henry Brunton and Mr Paterson were sent out to that quarter for the purpose of discovering some eligible situation for establishing a missionary settlement. After encountering not a few difficulties, they succeeded in obtaining passports from the Russian government, together with permission to remain at whatever place they should deem most suitable. Having fixed upon the residence of Karass, they were fortunate enough to obtain a piece of ground there, and certain privileges from the emperor. Encouraged by this favourable reception, the society sent out Mr Brunton's family and five missionaries in 1803, when two other settlements were established, the one at Astracan, and the other at Orenburg. To promote the object of their mission, and to excite discussions respecting the relative claims of Christ and Mahomet, throughout Circassia and the other parts of Tartary, Messrs Brunton and Paterson circulated a number of interesting addresses on the subject of religion in the Tartar language, which seemed to produce a powerful effect. But in the midst of these encouraging prospects their labours were interrupted first, by the appearance of the plague, and afterwards by the commencement of a war between the Russians and Kabardians, in consequence of which the missionaries and their families were thrown into such a state of alarm, that they were at last forced to abandon their situation and retire to a Russian fort, where, in less than twelve months six individuals belonging to the families of the missionaries fell victims to the ravages of disease. In 1805 some other missionaries were sent to the same quarter, having with them a printing-press and a font of Arabic types, for printing in the language most generally spoken and understood in the country. In order to further their success, several of the Tartars, who were in a state of slavery, were ransomed by the missionaries, and instructed in the useful arts of life and the principles of religion, in the hope of their becoming useful in propagating the Gospel. Among the natives who were baptised to the Christian faith was one of the sultans of the country, a youth of promising talents, well known under the name of Katagerry. In 1809, one of the Sonna chiefs sent a message to the missionaries, requesting them to employ some of their number to instruct his people in the Christian religion, although they already professed Christianity. Whilst the missionaries continued to circulate tracts through the country, in order to excite a spirit of inquiry respecting the principles they inculcated, the chiefs, having become extremely jealous, at length prohibited the reading of them under the severest penalties; and the tribes of Mahometans south of Karass likewise displayed, in behalf of their own religion, and against the missionaries, the most furious enthusiasm, all which circumstances proved extremely unfavourable to their hopes, and for a time paralysed their exertions. The number of persons belonging to the settlement in 1812, amounted to 165, of whom 25 were British, 6 missionaries, 122 Germans, and 18 natives; and, since the establishment of this mission, 27 natives have been ransomed, of whom 10 have been baptized. Owing to the continual state of alarm, and the apprehension of being attacked by the natives, this settlement was abandoned, and the missionaries, with their families, a second time removed to Fort Georghievsk, but they have again returned and resumed their labours. There are several circumstances which must operate powerfully against the conversion of this people. The Circassians and Tartars have an inveterate hatred against all Christians; and such are the laws of the country, that if a chief were to become a Christian, his slaves would be declared free, and if *any of his slaves discover an inclination to become a Christian, the chief has it in his power to kill him, sell him, or punish him in any other way he chooses.* How formidable an obstacle does this raise against the conversion of the natives to the Christian faith!

*Hindostan.*—Considering the long intercourse of Europeans with Hindostan, the number of Christians bears a remarkably small proportion to the immense population; but, indeed, the peculiar institutions and prejudices of the Hindoos present difficulties in the way of conversion more insurmountable, perhaps, than what are experienced in any other quarter of the world. Two missionaries were, by the king of Denmark, sent to Tranquebar in 1705, and this mission has succeeded so far that it now consists of four branches, Tranquebar, Vepery, near Madras, Trichinopoly, and Tranjore; and, it is said, about 54,000 persons have been baptized or received by the missionaries since its commencement. For upwards of a century the missionaries on the coast of Coromandel have been engaged in the conversion of the natives, and, according to some accounts, their endeavours have not been without some good effect. It appears that, by their talents and judicious conduct, they have generally insured to themselves the confidence and esteem of the natives. The venerable Mr Swartz, in particular, who was sent out to India in 1750, pursued his peaceable labours with the most unremitting ardour, and was held in the highest estimation by all classes of the people, and even by the late Hyder Ally himself, who looked upon him as *a holy man who meant no harm to his government.* This irreproachable missionary, whose knowledge and integrity, Colonel Fullarton observes, in his View of English Interests in India, "had retrieved the character of Europeans from the imputation of general depravity," died in 1798 in the 72d year of his age. After his decease the progress of the missionary work, though occasionally interrupted by untoward circumstances, was nevertheless encouraging, as appears from the account given by Dr Buchanan, who visited the principal settlements in 1806. The missionaries in this quarter have long been actually engaged in compiling religious and philological works. The Scriptures are now translated into the Tamul and Telinga languages; the Old Testament into the dialect of the Portuguese, which is spoken in India; and the New Testament, as well as some of the Old, into Hindostanee. Under the superintendance of Dr Carey, professor in the College of Fort-William, the Scriptures have been translated into upwards of 40 different languages of the east. In this department the Baptist missionaries have likewise peculiarly distinguished themselves, while their own liberality towards the cause in which they are ardently engaged is admirably conspicuous; no less than L.50,000 having been, within less than 20 years, contributed by themselves. These magnanimous exertions may be expected to have a powerful and salutary influence in advancing Christianity in the east, while, for its ultimate establishment in that quarter of the world, the extensive scale on which the education of the young is at present conducted seems peculiarly adapted. But indeed the Christianizing of Hindostan is an undertaking of so arduous a nature, that how to accomplish it most speedily and effectually is a question as difficult to answer, perhaps, as any within the range of human science. While the utmost exertions are making for the conversion of the Hindoos, it is evident that, on account of their strong religious prejudices, much must be left to the slow but certain workings of time. At present, however, no exertions are awanting; more than 300 schools are connected with the different stations in this interesting country, and these are intrusted to the care of native teachers, who are themselves under the cognizance of the missionaries. The number of children who are thus educated is supposed to exceed 18,000, and in many of the seminaries the Scriptures have begun to be used as a school book.

*Ceylon.*—Attempts were made in the 17th century by the Dutch to plant Christianity in the island of Ceylon, but unfortunately the means employed for this desirable purpose were in reality more adapted to make hypocrites than genuine converts. To induce the Cingalese to espouse the faith of their conquerors, and abandon the idolatrous religion of their ancestors, it was absurdly enacted, that no native could be raised to the rank of a modelair, or admitted to any employment under government, unless he subscribed the Helvetic Confession of Faith, and professed himself a member of the reformed church. By so impolitic a measure, a sufficiency of nominal Christians were readily procured; yet it is certain, that very many of the natives who profess Christianity are entirely ignorant of its principles, and still devoted to the worship of the idol Buddhu. But a good deal has been accomplished of late years by missionaries of different denominations, and especially by the Wesleyan Methodists, who in 1819 had established about 14 missionary stations throughout the island; while the number of children, including girls, attending the various schools, amounted to 4484.

*Java, &c.*—About the same period that the Christianizing of Ceylon was first attempted, ministers were by the Dutch sent to Java, Amboyna, Sumatra, Timor, and the adjacent islands, for the conversion of the natives, who have been supplied with the Scriptures in Malay. In these islands great multitudes submitted to baptism; but the real converts that have been made to the Christian faith are very few in number.

*China, &c.*—China has not failed to attract the attention of the missionary societies of England as well as that of the British and Foreign Bible Society; and translations into the Chinese language have been made of the Scriptures both of the Old and New Testament. These were partly translated by the Reverend Dr Morrison, the society's missionary at Macao, and partly taken by him from a valuable manuscript in the British Museum, a transcript of which he carried with him from England. As the individuals who assisted this gentleman to acquire the language, justly dreaded the consequences of their being discovered, the most inviolable secrecy was observed by both parties for the sake of their mutual safety, and he was thus enabled to compile several works chiefly of a philological nature. Mr Mylne was next sent out to aid him in his labours in 1812, at which time the prospects of the mission were rather unfavourable. This gentleman afterwards proceeded to Malacca, where an extensive establishment was formed by the united efforts of himself and some other missionaries, and where a college for Chinese, Malay, and Malabar children has been instituted, and various works in the Chinese and Malay languages printed and sent to different settlements in the Archipelago, to Siam, Cochin-China, and even to China itself. At this station, Dr Mylne, preached in the Mandarin dialect of the Chinese language twice every Sabbath, and on the evening of Thursday, while on the Sabbath another missionary, Mr Thomson, preached in Malay. These religious services, however, were attended by only a small number of the natives, though some apparently useful instruction was carried on with them at their own dwellings. Dr Mylne is since dead, but his coadjutor, Dr Morrison, lately visited England, and presented to the British and Foreign Bible Society the complete version of the Scriptures into the Chinese language, the fruit of 17 years labour; and various channels have been found for introducing this translation among the millions of China.

### *Missions in Africa.*

*Cape of Good Hope.*—The design of Christianizing the Hottentots was first formed by the Moravians. To those of them in the neighbourhood of the Cape of Good Hope, missionaries were sent in the year 1792, and they have persevered in their pious labours with amazing success, notwithstanding occasional interruptions. Their first settlement was at Bavians Kloof. Owing to the rapid increase of converts, a second settlement was proposed in 1808, and a third was afterwards begun near the borders of Caffraria. The latter settlement was entirely destroyed in 1819, by the Caffres, who attacked the colony and murdered several of the Hottentots, but the Brethren have been since enabled to return to that part of the country, and to resume their labours with better prospects of doing good. Upwards of 2000 Hottentots have been baptized since the commencement of this mission; and as the civilization of the people under their care is now attended to in a judicious manner by the missionaries, many of them are in consequence greatly improved in their outward condition, and occupy houses of several apartments, with gardens attached to them, which are surrounded with green hedges, and stocked with peach and other fruit trees, whose sweet fragrance perfumes the air.

In 1798 the London Missionary Society sent Dr Vanderkemp, a Dutch physician, with three other young missionaries, to the south of Africa, where above 12 settlements have been established by them, some of which are within the colony of the Cape of Good Hope, and others beyond its boundaries. At these settlements many thousands have reaped the benefit of religious instruction, and more than 1500 persons have been baptized. The civilization of the people is attended to as well as their instruction in the principles of Christianity. In every possible way the missionaries befriend them. They repair their ploughshares, to enable them the better to cultivate the land, they assist them with bullocks when they have lost their cattle, and with wheat for seed, on condition of its being returned next season; they likewise offer premiums to every Hottentot who builds a walled cottage, by the directions of the missionary who is appointed to superintend the works, and also furnish them with timber; and thus they not only instruct the natives, but likewise encourage and reward their industry and diligence.

Four missionaries from Holland landed at the Cape about the year 1804, and remained there for a period, after which they removed northward to Namaqua Land, where they met a favourable reception, and found it expedient, ere long, to establish a place of worship. Their congregation had, in 1808, increased to 700; but they were soon after obliged to quit this quarter for a time, owing to the depredations of one Africaner, a robber. But when Mr Campbell arrived in Africa he happily succeeded in obtaining the favourable opinion and good wishes of this individual, who, upon application being made to him, requested that a missionary might be allowed to reside at his krall, and immediately Mr Ebner was sent for this purpose. To the instructions of this pious missionary, the people of the surrounding neighbourhood listened with the most remarkable attention; and when Africaner at length perceived the mild and peaceable conduct of his attendants, and the wonderful change produced by the instructions of the missionary, he himself became seriously impressed with a sense of his own improper conduct. Instead of a persecutor, as he had formerly been, he now became a steady friend and supporter of the mission, and in about 12 months after was baptized at his own request. The mission was likewise countenanced and befriended by one of his sons. This station bids fair to be prosperous, and a church and several schools are connected with it.

*Susoo country, &c.*—The benevolent endeavours of missionaries who were sent to the neighbourhood of Sierra Leone, for the purpose of enlightening the natives of the Susoo country, although pursued with the utmost caution, were completely thwarted by the jealousy of the Susoos, together with other difficulties, arising chiefly out of the traffic in slaves, the abolition of which, extraordinary as it may seem, is in Africa regretted as one of the greatest evils that could befal the country. The demolition of the slave factories, and capture of the smuggling vessels by the governor of Sierra Leone, very much exasperated the Susoos, who attributed the loss of their trade to the interference of the missionaries, and therefore burnt the two settlements established in their country, while another settlement on the Bullom shore was likewise abandoned, chiefly owing to the pernicious influence of the slave trade, as the purchasers of slaves had used every effort to prejudice the inhabitants and their chiefs against them. Owing to these disasters, the missionaries retired, with a number of the children, to Sierra Leone, where a wide and important field of usefulness was immediately opened to them. Multitudes of slaves captured in smuggling vessels after the abolition of the slave trade, and conducted to Freetown, were humanely provided for by government in towns in different parts of the colony, until they were able to support themselves; and their instruction was attended to by the missionaries and schoolmasters of the Church society established in that quarter. About 2100 adults and children were attending the schools in Sierra Leone in 1819. In these schools the Lancastrian system of education has been introduced, and the prospects of future success are very encouraging. Sir George Collier, in two reports on the African settlements, bears ample testimony to the success of this mission, and he adds, "I do most conscientiously declare, never did I witness the ceremonies of religion more piously performed, or more devoutly attended to than in Sierra Leone."

### *Missions in North America.*

*Greenland.*—By the Danes considerable exertions have been made for the introduction of Christianity into Greenland. At the expence of their government, Hans Egede, a clergyman of Norway went, in 1721, to that dreary and inhospitable region for the purpose of converting the natives; and a missionary settlement was instituted, which, in the course of a few years, was in a somewhat promising condition. In 1733 the Moravian brethren of Germany established a settlement in the same quarter, which they designated New Herrnhuth. By means of the indefatigable labours of missionaries in the settlements, formed in different districts of this country, the Christian faith has been embraced by many of the natives, and its beneficial influence, in conjunction with that of civilization, begins to be conspicuous among them. The number of baptized Greenlanders, in 1816, connected with the three establishments of the Brethren, namely, New Herrnhuth, Lichtenfels, and Lichtenau, was 1152, a number constituting, perhaps, about one-sixth part of the whole inhabitants of Greenland. It certainly is peculiarly gratifying to perceive the pious labours of these philanthropic individuals crowned with such success, especially as they had to encounter, in the midst of their exertions, dangers and hardships which almost baffle description. At first they had to contend with serious difficulties in acquiring the language, because, though assisted by Hans Egede, they could not understand him until they had learned Danish. In a year or two after their arrival, they were threatened with destruction by famine, owing to the want of regular supplies, which, however, at length arrived in time to save their lives, when they proceeded, with renewed energy, in their exertions to humanize and instruct the barbarous natives. But new discouragements arose to distress them in their attempts. The savages treated them with scorn; interrupted their worship, by uncouthly imitating their singing, beating their drums, &c., and pelted them with stones, climbed on their shoulders, and robbed them of their goods. In addition to these and other abuses, they even endeavoured to deprive them of their boat, by means of which they obtained their main support.

*Labrador.*—The Brethren, whose zeal and activity are peculiarly worthy of imitation, have done much, in communicating the blessings of religion and civilization in different parts of the globe besides that now alluded to, and have even succeeded in making converts among the Esquimaux on the shores of Labrador. Their exertions commenced in that country in 1771, and from that period to 1817, the number of natives baptized by them at the settlements of Nain, Okkak, and Hopedale, amounted to about 600. The New Testament is translated into their own language, while the schools are attended by adults as well as children. How the missionaries have found means of successfully carrying on their labours of love among the Esquimaux in this quarter is not a little surprising, especially as these barbarians usually assign to Europeans the highest place in the scale of criminals, and are, at the same time, by no means readily convinced of their own depravity and ignorance. It is highly creditable to the Brethren, that before they, with a noble enthusiasm, travelled over the ice to this race of savages, scarcely any European would, on any consideration, have ventured alone amongst them. Of the superstition of the inhabitants of Labrador, the following anecdote, respecting their dread of written language, is a striking instance: When a declaration of friendship from the governor of Newfoundland was read to them by one of the missionaries, they could not be at all persuaded to take the paper into their hands, being afraid that there was something living in it, which could thus convey the thoughts to them of one who was so far distant, and which might afterwards prove injurious to them.

*United States.*—Among those persons who took refuge in the wilds of America, in consequence of the troubles both in church and state, after the succession of the house of Stuart to the throne, was Mr John Elliot, who commenced preaching to the Indians in Massachusets in 1646, and who, at a subsequent period, translated the Scriptures, and some other useful books, into their language. By the labours of this excellent man, together with those of some other ministers, the natives were, in the course of time, a good deal civilized, while they likewise acquired some knowledge of the principles of Christianity. There were in New England, in 1687, six churches of baptized Indians and eighteen assemblies of Christian catechumens; and, besides four English ministers who preached in the Indian language, more than 20 of the natives themselves had become preachers of the gospel. For some time after the death of Mr Elliot, who was styled the apostle of the Indians, the churches continued in a flourishing condition; but they mingled, in course of time, with the English settlers, and from this circumstance, few now remain that are purely Indian.

While the Indian tribes of Massachusets were benefiting by the instructions of Mr Elliot, a similar undertaking occupied the family of the Mayhews in Matthew's Vineyard, Nantucket, and Elizabeth Isles; and, notwithstanding the death of the missionary Mr T. Mayhew, several Christian churches were erelong established. In Matthew's Vineyard, the progress of Christianity had been considerable so late as 1792, at which period the missionary was one of the Mayhew family. But raging diseases, together with intermarriages and other causes, have since lessened the number of the Indian families, so that, comparatively, few traces of the congregations or churches now remain.

Animated by the example of Mr Elliot, a number of ministers, in the colony of New Plymouth, associated themselves together for the purpose of converting the Indians. To accommodate such as should embrace the Christian faith, a town was built within 50 miles of Boston, and, by means of the unremitting labours of the ministers successively stationed in this district, the number of converted Indians was gradually augmented, and up to the year 1807 had by no means diminished. The congregation of Indians at Stockbridge, near the river Housatunnuk, was a similar settlement originally established, by the labours of Mr John Serjeant, after whose decease it came under the care of that eminent pastor Jonathan Edwards, who experienced much encouragement in attending to his charge, during the few years he continued. The Stockbridge Indians, as they are now called, have improved considerably in the emollient arts of life, and none of them are supposed to adhere to Paganism. Their number, in 1811, was said to be 475.

About the year 1725 Dr Berkley, bishop of Cloyne, made a benevolent but unsuccessful effort for converting the American Indians to Christianity, by erecting a college in Bermudas, and supplying the churches in the plantations with proper teachers, but, after a residence of seven years, he was compelled to return, mortified at his failure, as has already been noticed in the biographical sketch given of him.

We must not here omit to notice the mission of New Jersey, which was promoted by that excellent Christian, Mr David Brainerd, under the auspices of the Society in Scotland for propagating Christianity. The toils and hardships which this individual underwent were peculiarly distressing, as appears from his own unvarnished yet affecting account of them. He began his labours at Kanaumeek, a place twenty miles distant from Albany; but, notwithstanding the forcible and salutary impressions which his ministrations were peculiarly calculated to make, he succeeded there in little else but securing the esteem of the natives, and effecting a partial amendment in their manners. Removing to the Forks of Delaware in Pennsylvania, he drew together between thirty and forty Indians; and, besides statedly exerting himself among the congregation thus formed, he extended his ministrations, with ardent zeal, to various distant tribes. His ultimate success, after encountering many severe troubles and discouragements, was really amazing. In particular, at Crosweeksung in New Jersey, 80 miles distant from the Forks of Delaware, very many were converted by him to the Christian faith, and the few that he baptized were in all probability seriously convinced of the excellency of Christianity. A school was opened in 1746 for the education of the young in reading and writing the English language, and a church was likewise formed shortly after. Mr Brainerd having died in 1747, at the early age of 30, was succeded by his brother, whose correspondence with the society in Scotland was unfortunately suspended during the American war, towards the close of which he himself also died. These adverse circumstances had a melancholy tendency on the church and congregation of Crosweeksung, the remainder of whom were at length removed to the settlement of New Stockbridge.

With the view of instructing some of the Indian tribes in the religion of Christ, a number of Moravian Brethren sailed for North America in 1743. This mission was long in a prosperous condition, though in the end it proved unfortunate in the extreme. In the prosecution of their peaceful labours, the missionaries were subjected to the most inhuman barbarities, and many of them were at length massacred in 1755, by a party of French Indians, who at the same time wantonly destroyed by fire the whole property of the Indian congregation. Owing to the persecutions to which the congregation was exposed during the American war, it was removed from the settlements which had been formed on the river Muskingum to Sandusky, where great distresses ensued from the want of the necessaries of life. In this sad dilemma, the Christian Indians returned to their former station to procure the corn which had been left growing in the fields. Here they were surprised and taken prisoners by the Americans, who lay in wait to destroy them; and on the following day no fewer than ninety-six persons were scalped and butchered in cold blood by these inhuman barbarians, who, in return, met with just vengeance from the swords of their foes; for the greater part of them were ere long cut to pieces by a band of English and Indian warriors. The mission never recovered the melancholy calamities to which it thus fell a prey. From its commencement the Brethren are supposed to have baptized about 1400 Indians, and there are still three small settlements among them.

The Boston Recorder furnishes a pleasing account of the progress and revival of religion in the various schools, academies, colleges, and congregations in this quarter during the last twelve or eighteen months, from which it appears that 98 Presbyterian congregations, 107 Baptist, 139 Congregational, 55 Methodist, 8 Reformed Dutch, in all 407, have shared of the blessed effects of divine truth, and that the number of hopeful converts is about 26,764. Mr Vail, the superintendant, in his annual report to the secretary of war, states, that one great object of Indian missions is to bring the natives to habits of industry, and that every inducement is held out to them by offering them a compensation for their labour. While some of the children of the Asage nation attend the schools, the people themselves are instructed in the art of building, the erection of mills, and other useful employments; and, as a proof of their success in the conversion of the natives, it is stated, that the most powerful chief of the Pagan party at Cataraugus has been converted, and has brought his children to the mission school.

### *Missions in South America.*

*Berbice, &c.*—A few of the United Brethren sailed for Berbice in South America, in the year 1738, with the view of converting and civilizing the Indians, and two others were sometime after sent to a Dutch settlement near Surinam, where they laboured for a period of ten years with tolerable success, but were in the end compelled to quit the place by an insurrection of the slaves. A more prosperous attempt was made among the negroes about Paramaribo, in which quarter the congregations consisted of 817 members, in the year 1816.

*Demerara.*—In Demerara considerable exertions have been made among the negroes by the Methodist missionaries, as well as by some sent out by the London Missionary Society.

### *Missions in the West Indies.*

Two of the Moravian Brethren proceeded in 1732 to St Thomas, one of the West India islands belonging to the Danish government, and their ministrations were listened to with attention by the negroes, about 800 of whom had received instructions in 1738. But these individuals had numerous difficulties to encounter, till protection was granted to them from their malignant enemies. In the course of a few years this mission became very prosperous, and the governor of the island and most of the planters began at length to approve of the meritorious endeavours made to improve the minds of the negroes; for observation taught them evidently, that while Christianity meliorates the bondsman's condition, it tends at the same time to render him a more effective and valuable servant.

Other missions were afterwards established at St Croix, St Jan, Jamaica, Antigua, Barbadoes, and St Christopher's, and some of them have experienced a considerable degree of encouragement. Additional missionaries, as well as clergymen of the established church, have lately been sent to Jamaica and other stations in the West Indies. According to the latest accounts, the two congregations at the settlement of New Herrnhuth and Niesky, in St Thomas's, amounted to upwards of 2250, being a great proportion of the whole number of slaves. There are in St Croix three establishments with flourishing congregations; and, from the commencement of the mission, a great number have been baptized by the Brethren, whose endeavours in St Jan, and other of the larger islands, have likewise been attended with promising success; and the last accounts from Jamaica, addressed to the secretary of the Edinburgh Association, state, that the prospects of the missionaries in that quarter were never so cheering; that at three stations the number attending the instructions of the missionaries is upwards of 2000, and that at St Kitts, during last year, there has likewise been a great increase. At Montserrat 150 individuals attend the mission school.

The magnanimous attempts of the Methodists in these islands, since Dr Coke, with three associates, first visited Antigua in 1780, are likewise worthy of particular notice, as they have, notwithstanding great difficulties and opposition, no doubt effected much good among the Negroes. The members of the Methodist societies in the West Indies, according to accounts received in 1820, amounted to upwards of 22,000, besides 36 missionaries, and about 120,000 stated hearers. But we regret to state, that, from numbers of the white inhabitants, great hardships and sufferings have been experienced by the missionaries, both Moravian and Methodist, in this quarter, and the distresses to which they have been subjected, owing, perhaps, to the imprudent conduct of a few of them, are scarcely to be credited. Not only were they interrupted in their labours by mobs, but they were assaulted by violent and outrageous individuals; and several acts were, moreover, passed restricting them in their operations, and in case of transgression, rendering them liable to be punished by fine and imprisonment. It appears, however, that though they have numerous opponents, they are not without friends, even among the planters themselves, some of whom have shewn a disposition to countenance and support them. Among so many missionaries there may in all probability be some individuals whose character or conduct may be reprehensible; but if missionaries were regularly ordained, such evils as result from their misconduct could seldom take place, since they would always be responsible to their superiors. Mr Watson, however, in his defence of the Wesleyan Methodists, not only exonerates the missionaries in the West Indies from all aspersions, but also demonstrates, that the hostility towards them was by no means universal. "A great part of the money," says he, "expended by the West India mission has been raised in the colonies, of which a considerable sum has been raised by the whites. There is scarcely a chapel of any magnitude in any of the islands in the erection of which the gentlemen of these islands, and the clergy themselves, have not assisted by their subscription or otherwise. They have given money, lent money in considerable sums till it could be conveniently repaid, made presents of timber, or furnished it on long credit, and lent their Negro masons and carpenters *gratis.* Subscriptions of ten, twenty, fifty, and one hundred pounds, for such purposes, mark both the rank in life and the opinions of the contributors. Even in Jamaica, where the dark and dangerous fanaticism of the Methodists has been discovered, with more sagacity than in any other place, this assistance has been afforded. The clergy, though not in general personally active in Negro instruction, have given proofs that they are not opposed to the efforts made for that purpose, and that they apprehend no danger from them. It has not been an unusual thing for their slaves to be members of the Methodist societies by their wish or consent."

### *Missions in South Sea Islands.*

The operations of the Missionary society formed in London in 1795, commenced with a mission to the South sea islands. In the following year, 29 missionaries embarked for these islands, and arrived at Otaheite in March 1797, where some of them remained, while others made choice of Tongataboo, one of the Friendly islands, and two settled in St Christina, one of the Marquesas.

No good whatever was effected at Tongataboo and St Christina; and indeed the hardships to which the missionaries were at first exposed, at Otaheite, seemed likewise to blast every anticipation of the possibility of evangelizing the natives of that island. Subsequent to the year 1811, however, the ministrations of the missionaries had a powerful effect, both in Otaheite and Eimeo; and this auspicious revolution extended even to the islands Tetaroa, Tapua-Manu, Raiatea, Huaheine, Taha, Borabora, and Marua. In the different islands the natives were instructed in the doctrines of Christianity, and taught to read and write their own language, and it was supposed that above 6000 persons were thus qualified to read, more or less perfectly. In every district of Otaheite and Eimeo, schools were erected by order of Pomare the king, who himself embraced the Christian faith, and was baptised, and the art of printing has been introduced and actively put in practice in these islands. An impression, consisting of 3000 copies of the gospel of Luke, was printed and sold at the rate of three gallons of cocoa nut oil per copy; and so great was the demand, that it is supposed an impression of 10,000 copies might have been disposed of in ten days. By the labours of the missionaries in these islands, an effectual check has been put to idolatry, infanticide, and other sinful practices, and the condition of the people is in all respects remarkably improved. The sacred rest of the Sabbath is strictly observed; secret prayer is generally practised, and family worship is conducted statedly in almost every house. It is moreover gratifying to know, that an auxiliary missionary society, under the patronage of Pomare, has been established. The inhabitants of these islands being naturally of a mild and peaceable disposition, to this may be owing, in no small degree, the success of the missionaries in their conversion.

### *Mission in Australasia.*

In the Australasian mission, the exertions of the Reverend Mr Marsden are remarkably worthy of notice; for though but little has been accomplished, the prospects of future good are very encouraging. The mission on New Zealand was instituted in 1814, by the liberality of the Church Missionary society. Mr Marsden made his third voyage to this quarter in 1820, and ardently exerted himself to promote the objects of the society, by instructing the natives in the arts of life, and in the knowledge of the Christian religion.

### *General Observations.*

It may be remarked, that in their direct attempts to civilize savage nations, missionaries have of all men the greatest and best opportunities, and have been the most successful. They find the most easy access, and are generally the most hospitably received. Appeals might be made even to the effect of the missions of the Jesuits, though their Christianity was defective, and in too many instances the extension of their own power the prominent object. Christianity has the most powerful influence, when gradually and prudently introduced, in ameliorating the civil with the moral condition of man. In short, the introduction of Christianity is itself civilization; for, wherever it is introduced, it must inspire the most humane, mild, and benevolent dispositions. Otaheite, the Sandwich, and other islands in the South sea, may be appealed to as proofs of this fact; and what traveller was ever able to penetrate so far into Africa from the south as Campbell, or has more benefited the natives by his visits.

In addition to the missions now mentioned, many others might be noticed; but we content ourselves with giving this rapid sketch, as embracing the most important attempts that have, with any degree of success, been made for the evangelizing of the heathen in the various quarters of the habitable globe. On taking a cursory view of the progress of missions in general, we cannot help observing, how remarkably ineffectual have been all the pious exertions made in the work of conversion, especially in the east. Far be it from us to advance any observations, on this point, calculated to discourage, in individuals or societies, the laudable disposition of propagating a knowledge of the gospel in heathen nations; but as even the wisest and best men are found to differ in their opinions respecting what are the most effectual means to be adopted for accomplishing so desirable an end, and as, upon the success of missions, men are found not unfrequently to speak more from their sanguine hopes than from indisputable facts, every unbiassed Christian must be desirous of the fullest information on a question of such moment.

It seems, indeed, extremely questionable, how far Christianity can become the religion of men in a savage state. Its doctrines are too refined, its laws are too pure, and its ordinances too simple to be accommodated to the notions and habits of men utterly rude and ignorant. In this opinion many great and good men are found to concur. The learned and pious Bishop Warburton, after making a contrast between the conduct of the Romish and Protestant missionaries to the heathen, and lamenting the ill success of the latter, observes,—"Something therefore must needs be much amiss, to defeat a purpose which grace and nature conspire to advance; and if we search carefully into it, we shall find it to be this, *the preaching of it to savage and brutal men.* For the gospel, plain and simple as it is, and fitted in its nature to what it was ordained to effect, requires an intellect something above that of a savage to apprehend it. Nor is it at all to the dishonour of our holy faith, that such a one must be taught a previous lesson, and, first of all, instructed in the emollient arts of life. And it is not one of the least benefits of society, that at the time it teaches to improve every bodily accommodation, it enlarges and enlightens the understanding by the activity which the mind exercises in improving their accommodations. For want of this previous culture, it hath happened, that when, by the unwearied labour of the missionary, numbers of these savages have been baptized into the faith, such converts have never long persevered, nor were they able to propagate, among their tribes, the Christianity they had been taught, but successive missionaries have found the work was ever to begin anew. From whence we may conclude, that the missionaries set out at the wrong end; for, to make the gospel understood, much more to propagate and establish it, these barbarians should have been first taught the civil arts of life. And, indeed, to civilize a barbarous people is itself a work of such exalted charity, that to find it neglected, when a farther and far nobler end than the arts of life may be procured by it, is matter of infinite astonishment." If it were possible to convert a savage into a Christian all at once, this would be, in other words, to civilize him. The character of the true Christian must uniformly include a certain degree of mental improvement, together with all the amiable qualities which adorn human nature, and which are the concomitants of a state of refinement and civilization.

The plan of universal conversion, acted upon by missionaries in general, seems to have but little to recommend it. Instead of commencing their labours, on their first introduction into foreign countries, by inculcating religious doctrines, the most sublime and mysterious, and indiscriminately baptizing all who affect to profess a belief in the principles of a religion of which they must be in a great measure ignorant, they would do well first to instil useful knowledge into the minds of those heathens whose conversion they endeavour to accomplish, by which means they would enable them to perceive the absurdity of their idolatrous superstitions, and prepare them for embracing the gospel with unfeigned sincerity.

By beginning with the most abstruse doctrines, which men of uncultivated reason cannot possibly comprehend, they not unfrequently dwell on these topics till their attendants turn from them with disgust, and will hear no more. This error has been carefully avoided by most, if not all, of the Protestant missionaries from this country, and likewise by the Moravians, who, probably for this reason, have been more successful in their labours than any other missionaries. The first object of the Brethren is to induce the inhabitants to live together, and to form permanent societies; after which, they begin to inculcate all the social virtues, and to teach them habits of sobriety and industry; thus practically demonstrating to them the blessings of social happiness, and that the Christian religion is better adapted to promote their best and highest interests, than any other. Convince them of this, and they cannot fail to believe any doctrines, and to embrace any religion which happily tends to such great and noble results. Till this be effected, it is a mistake to think that, by baptizing the heathen, they can in truth be made Christians, as the true meaning of the rite of baptism can neither be understood by them, nor the spiritual doctrines of the gospel, nor its moral virtues and obligations. The Protestant missionaries, therefore, proceed with the greatest caution and circumspection, and it is not till after long and careful observation of the conduct of professed converts that baptism is administered by them. On whatever slight evidences converts in the east may have been admitted to this Christian privilege, this error certainly has not been committed by the missionaries employed by the societies of this country and America.

It is an undoubted fact, that the great bulk of converts to Christianity in India have been commonly actuated, not by conviction or the force of truth, but by the most sinister motives, as appears from the frequent instances of apostacy among them. On this head we may adduce, from Bowen's Missionary Incitement and Hindoo Demoralization, the testimony of Rammohun Roy, the author of *Precepts of Jesus*, who is now a strict deist, and is forming a system of morals out of the Koran and Christian religion, and who, though latterly an apostate, was, for a period, greatly celebrated as a distinguished convert. This person was not a Brahmin, but a Hindoo, and continued to observe all the ceremonies of the Hindoos, that he might not be excluded from his caste. "Notwithstanding every exertion," says he, "on the part of our divines, I am not aware that we can find a single respectable Mussulman or Hindoo, who was not in want of the common comforts of life, once glorified with the truth of Christianity, constantly adhering to it. Of the few hundred natives who have been nominally converted to Christianity, and who have been generally of the most ignorant class, there is ground to suspect that the greater number have been allured to change their faith by other attractions than by a conviction of the truth and reasonableness of the doctrine, as we find nearly all of them are employed or fed by their spiritual teachers, and, in case of neglect, are apt to manifest a rebellious spirit." The remark, that *rice and cloth* are the gods of the Hindoo Christians, has very naturally arisen from such a state of things; and, indeed, the following petition, transcribed from the work just quoted, shews, in a striking manner, the truth of the allusion, and that Rammohun Roy, in his opinion, has not been altogether mistaken:

"To the Right Reverend Father in God, Thomas, Lord Bishop of Calcutta, the humble petition of Rutton Ghose, Kantoo Doss, Needy Ram Saha, Bhyrobchund Mullick, Budhee Saha, Bokul Saha, and Gour Dhobee, for themselves, and on behalf of one hundred Christian converts:—

"*Sheweth*—That your petitoners are by birth Hindoos, and heretofore did, as is the custom of Hindoos, perform the worship and ceremonies of their religion, as laid down in the Shastras, and other holy books, agreeably to the rites which have been established from time immemorial in these regions.

"That some years since, certain people, denominated missionaries, arrived from Europe, for the express purpose of converting the natives of this country to the Christian faith. Among these missionaries, one named William C——, better known by the name of Dr C——, did, by the seductive art of persuasion, and by artful representations of the truth and efficacy of the Christian doctrines, as the only sure and certain guides to salvation, at the same time condemning the Shastras, Tantras, and Pouranns of the Hindoos, to be the works of Satan, and, as such, would unavoidably lead their believers to damnation and eternal punishment, so operate on the minds of your petitioners, that, led by their fears on the one hand, and seduced, on the other hand, *by the hope of support and protection, which he held out to such as would embrace the religion of Christ,* your petitioners were induced to forsake the religion of their ancestors, and to suffer the ritual of baptism.

"Your petitioners, placing entire reliance and confidence on the word and faith of Dr C——, (for how could they suppose that a teacher of Christian morality could be found defective to his promises?) became converts to his doctrines, and were baptized, as they were taught to think, into Christ his church: But what must be the poignancy of their feelings to discover, that these flattering prospects of support and protection are as unstable and fleeting as the visionary objects of a dream. Expelled from their caste, and expatriated their homes and families, deprived of the countenance and support of those to whom they are allied by the ties of nature, and become objects of contempt and derision to their Hindoo brethren, they now, in this state of humiliation, experience the fallacy of those promises by which they were deluded. Condemned, like outcasts of society, to depend for a precarious subsistence on the lukewarm generosity and beneficence of strangers, to whom shall your petitioners, in the overwhelmings of their affliction, look up for support and protection, unless to your Lordship, who hath been selected to fill the highest and most respectable station of the Episcopacy in India.

"Your petitioners, therefore, most humbly solicit your Lordship's attention to their miserable condition; and, with hopes of exciting your Lordship's commiseration, they humbly crave permission to approach your Lordship with this relation of their sufferings;—and your petitioners, as in duty bound, shall ever pray.—*Calcutta, June* 16, 1817."

Among the many obstacles which retard the progress of Christianity in the East, those arising from the institution of castes, or perpetual orders of men, the characteristic marks, rights, and duties of which have been continued from the earliest period of their history, prove the most insurmountable. The converts that have from time to time been made by the missionaries, were, with hardly any exceptions, obtained from the very dregs of society; and, indeed, from the very nature of things, it could not be otherwise, for every respectable Hindoo is aware that, if he embrace the faith of Christ, this act will be immediately followed with the utter loss of character, wealth, rank, and emolument. Numerous and severe are the hardships resulting from the conversion of the Hindoos. The convert, by renouncing the institutions of his ancestors, is deprived of all domestic and social felicity, and even entails on himself the most deadly hate of those who formerly loved and cherished him, and that without obtaining in a new community such estimation as might counterbalance his privations. In such circumstances, it may be asked, how is it possible that the great mass of the Hindoo population can be converted to the Christian faith, till, by the cultivation of their intellectual faculties, their prejudices have been softened, if not entirely eradicated? It must be admitted by every intelligent individual, that to convert them to the faith of Christ, by the system commonly pursued, appears perfectly impracticable. By inveighing against the prejudices of the Hindoos, the missionaries absolutely retard the progress of their labours of love; whereas their success might ere long be encouraging, did they pursue a more conciliatory and judicious mode of procedure. From the testimony of the missionaries themselves, we may learn how little has been effected by their most ardent exertions. The Abbe Dubois, in his Letters on the State of Christianity in India, thus expresses himself respecting the conversion of the Hindoos:

"For my part, I cannot boast of my success in this holy career, during a period of twenty-five years that I have laboured to promote the interests of the Christian religion. The restraints and privations under which I have lived, by conforming myself to the usages of the country; embracing, in many respects, the prejudices of the natives; living like them, and becoming almost a Hindoo myself; in short, by 'being made all things to all men, that I might by all means save some'—all this has proved of no avail to me to make proselytes!

"During the long period I have lived in India, in the capacity of a missionary, I have made, with the assistance of a native missionary, in all between two and three hundred converts of both sexes. Of this number two-thirds were Parias, or beggars; and the rest were composed of *Sudras*, vagrants, and outcasts of several tribes, who, being without resource, turned Christians, in order to form new connections, chiefly for the purpose of marriage, or with some other interested views. Among them are to be found some also who believed themselves to be possessed by the devil, and who turned Christians after having been assured that on their receiving baptism the unclean spirits would leave them never to return: and I will declare it, with shame and confusion, that I do not remember any one who may be said to have embraced Christianity from conviction, and through quite disinterested motives. Among these new converts many apostatised, and relapsed into Paganism, finding that the Christian religion did not afford them the temporal advantages they had looked for in embracing it; and I am verily ashamed, that the resolution I have taken to declare the whole truth on this subject forces me to make the humiliating avowal, that those who continued Christians are the very worst among my flock.

"In fact, the conversion of the Hindoos, under existing circumstances, is so hopeless a thing, and their prejudices against it are so deeply rooted, and so decidedly declared, that I am firmly persuaded, that if (what has never been the case) the Hindoo Brahmins were animated by a spirit of proselytism, and sent to Europe missionaries of their own faith, to propagate their monstrous religion, and make converts to the worship of Seeva and Visnoo, they would have much more chance of success, among certain classes of society, than we have to make among them true converts to the faith in Christ." He further adds, "Owing to their abrupt attacks on the most deep laid prejudices of the country, the zeal of the Hindoos had been roused to a determined spirit of opposition and resistance, when they saw their most sacred customs and practices publicly reviled, laughed at, and turned into ridicule, by words, and in writing, in numberless religious tracts, circulated with profusion, in every direction, all over the country."

Upon the whole, therefore, it seems obvious, that, in evangelizing the heathen, it is only by first instructing them in useful knowledge, and in the arts of life, by accustoming them to compare, to reason, and to reflect, by enabling them to apprehend the reasonings and arguments of others, and the force of truth; it is only by such means that, without a miracle, they can ever be brought to discern the superior excellence of Christianity, or, through conviction, can adhere to the faith of the gospel. For the accomplishment of these purposes, the establishment of schools seems, so far as it goes, admirably adapted; and the missionaries themselves seem now to be aware, how important it is to excite them to industry, to encourage among them the arts of civilized life, and to attach them to the comfort of a settled abode, before they can possibly derive the full benefit of their instructions and example. Had the immense sums which in Britain alone have been so industriously collected of late years for the support of missions, been properly applied, by an unity of design under the direction of the church and the legislature, in the permanent establishment of colleges and colonies, there is reason to believe that the laudable zeal and almost incredible labours of the pious missionaries would have been crowned with much greater success.

It appears that upwards of 400 missionaries, supported by British contributors alone, are at present employed for propagating the gospel in foreign parts, at an annual expense of nearly L.300,000. Had this vast sum been properly expended upon this laudable undertaking, it may be presumed it would have been amply sufficient for the support of 200 colonies, in any the most eligible situations that might have been selected in Europe, Asia, Africa, and America, even supposing they had each consisted of six families. Allowing, then, that a clergyman, as a missionary, an agriculturist, and four of the most generally useful artizans, with their families, had been established in any foreign country, and annually supplied with the materials most necessary for their comfort and support, there can be no doubt that the valuable knowledge of Christianity, of the arts of life, and of European customs and habits, which they would have gradually introduced among the natives, would, in time, have induced them to imitate their example, and would thus have led them to perceive how infinitely superior the religion of Jesus was to the worshipping of idols. By this very means the converts to Christianity would have been prevented from returning to their former ignorance and idolatry.

So much convinced are the missionaries themselves of the advantage and the necessity of previous instruction, that they are now more attentive than formerly in civilizing the natives, not only by the establishment of schools, but by remunerating their labour and industry, and by leading them to permanent settlements. Among barbarians, it is true, there has been one, a public robber, and an absolute savage, Africaner, who was induced to profess himself a Christian; but even this change did not take place till, at his own krall, and with his own eyes, he had witnessed the regular, kind, and peaceable conduct and manners of the missionaries and their attendants, for twelve months before he earnestly entreated to be baptized; so that, in the course of this time, his manners and habits must have been, in some degree, softened and improved both by instruction and example. If it were possible for men in a savage state to be converted to Christianity, their continuance in this profession would be of short duration; and those who thus embrace the Christian faith without any conscientious motives, it has been found, by experience, are equally ready to abjure it, and generally do so whenever a sufficient inducement is held out to them, or whenever they become displeased or offended with their instructors. It would be rash to maintain that not one solitary instance could be mentioned as an exception to what is above stated, although the apostacy which frequently takes place among heathens thus converted affords too much reason to think that instances of real conversion among them are extremely rare. The Church Missionary Society themselves, in their own reports, candidly acknowledge, that out of twenty converts made at one of their stations in the course of a few years, all relapsed into heathenism except one;—a circumstance which evidently shews that there must exist some material defect in the plan of Christianizing India; and that to preserve them from apostacy, the light of divine truth must not only appear, but must continue permanently to shine and to diffuse all its excellence and all its glory around them.

The reader who may be desirous of further information respecting the Protestant missions, is referred to Mosheim's, and especially to Jablonski's *Ecclesiastical History*; Brown's *History of the Propagation of Christianity among the Heathen*; Loskiel's *History of the Mission of the United Brethren in North America*; *Moravian Periodical Accounts*; *Baptist Periodical Accounts*; Missionary Register, 7 vols.; Reports of the Various Missionary Societies. Respecting the real state of Christianity in the East, much information will be derived from Brown's *Incitement* already noticed, Major Scott Waring's Tracts *on Indian Conversion,* Lieutenant White's *Considerations on the State of British India,* and Murray's *History of Discovery in Asia.*

MISSISSIPPI, a very large river of North America, separating the United States from the country of Louisiana. It extends from Red Cedar lake, in north latitude 47° 28′, and 95° 2′ west longitude, to the gulph of Mexico, a distance of about 3500 miles. Among the principal tributary streams by which it is augmented may be noticed the Missouri, Arkanza, and Red river, from the west, and the Illinois and Ohio from the east; and its general course is from north to south. This great river, which waters about five-eighths of the United States, is navigable, without any obstruction, as far as St Anthony Falls, where the stream, which is of very considerable width, has a perpendicular fall of upwards of 16 feet; and the rapids below, in the space of 300 yards, render the descent above 50 feet more. Salt of excellent quality is produced from the salt springs on each side of the river, and the adjacent country is as fertile as any other quarter of North America. Coal is said to be abundant on the upper branches of the Mississippi. The melting of the snow occasions great inundations of this river, which overflows the country, for upwards of 60 miles on both sides, between the months of May and July.

MISSISSIPPI, a considerable district of America, bounded on the north by Tennessee, on the east by the Alabama territory, on the south by the gulph of Mexico, and on the west by Louisiana and the Missouri territory. It is watered chiefly by the Mississippi, Mobile, Yaroo, Pearl, and Pascagoula; and is very productive of corn, indigo, vegetables, and fruit. *Natchez*, the capital, has an elevated situation on the east bank of the Mississippi, and contains about 1500 inhabitants, including nearly 500 slaves.

This district, formerly occupied by the Creek, Chactaw, Chickasaw, and Cherokee tribes of India, was, in 1800, erected into a territorial government, and divided into three counties, Washington, Pickering, and Adams. In 1817, it was constituted one of the United States, and divided into twelve counties,—Adams, Jefferson, Clairborne, Wilkinson, Amise, Warren, Franklin, Marion, Pike, Hancock, Lawrence, and Wayne. The whole population, in 1816, was about 44,300.

MISSOURI, a great river of Louisiana, formed by the conflux of three streams in north latitude 45° 23′, and west longitude 110° 5′, and having a sinuous course of above 3000 miles to the Mississippi, and is said to be navigable for 1300 miles. It presents different rapids, cascades, and falls, and contains a number of islands. According to the accounts of Captains Lewis and Clarke, the Missouri, at the distance of 3848 miles, by the course of the river, from its junction with the Mississippi, divides into three branches, called by them Jefferson's, Madison's, and Gallatin's rivers; and the first of these, which is the only one explored, is navigable for 248 miles. The Missouri has several bends, the principal one of which is 30 miles. The banks of this river present an agreeably fertile aspect.

MITE, a small piece of money alluded to in Luke xii. 59. and xxi. 2. It was equal to a quarter of the Roman denarius, and worth nearly twopence of our money.

MITRE, a sacerdotal ornament for the head, worn by bishops and certain abbots on particular occasions. Four different mitres are used by the Pope, and are more or less rich according to the solemnity of the feast days in which they are made use of. A mitre or bonnet was worn by the high priest among the Jews, and the inferior priests also had their mitres.

MITTIMUS, in law, implies a writ for removing or transferring of records from one court to another. It is likewise a precept or command in writing under the hand and seal of a justice of the peace, directed to the keeper of some prison, for the receiving and safe keeping of an offender till he be delivered according to the terms of law.

MIZEN, in sea language, denotes a particular mast or sail. The mizen-mast is in the stern or back-part of a ship; and besides it, in large vessels, there are two others, one next the main-mast, called the main mizen, and the other near the poop, called the bonaventure mizen. The sail of the mizen mast is termed the mizen sail, and is at sea always denoted by the word mizen. The purpose of the mizen is to keep the ship close to the wind, and it is used when a ship rides at anchor to back her astern.

MNEMONICS. See Memory.

MNEMOSYNE, in heathen mythology, the goddess of memory, and daughter of Cœlus and Terra. She married Jupiter, by whom she had the nine Muses.

MOAB, in ancient geography, a country of Arabia Petræa, and so called from the son of Lot, to whose posterity it was allotted. It was situated south from Ammon, and was bounded by Arnon on the north, the Asphalites on the west, and the mountain Abarim on the east. Moab was originally inhabited by the Emims, a race of giants, whom the Moabites extirpated.

MOAT, or Ditch, in fortification, a deep trench round the ramparts of a fortified place, for the purpose of preventing surprises. The brink next the rampart is called the scarp, and the opposite one the counterscarp. The nature of the soil, together with other circumstances, must regulate the breadth and depth of a moat. A wet moat, which is partly or wholly filled with water, and which should be equally deep in every part, is preferable to a dry moat; and if it have sluices or flood-gates, it has the advantage of being rendered dry at pleasure. The dry moat is generally deeper than the wet one. It has sometimes a row of palisades planted nearly in the middle, and has likewise a cuvette, or trench, for retaining a supply of water. A flat-bottomed moat has its corners somewhat rounded; and, in a lined moat, the scarp and counterscarp have each a sloping wall of masonry.

MOBILITY denotes capacity or aptitude to be moved, and, in respect of the earth and heavenly bodies, constitutes an important branch of astronomical inquiry. About 500 years before Christ, the mobility of the earth about the sun was maintained by Pythagoras, but it was denied by Ptolemy and his followers in the year 130; and the earth continued afterwards to be viewed as occupying the centre of the universe, until Copernicus, about the middle of the sixteenth century, demonstrated the contrary, and thus alarmed the holy fathers of the church, by whose appointment commissioners were immediately engaged to examine into the subject. In consequence of this inquiry, an absolute prohibition against the doctrine of the mobility ensued, because, amongst other reasons, they judged it incompatible with the views of scripture. Such, however, is the happy progress of science in our times, that the doctrine of Copernicus and the words of scripture are, to the intelligent and judicious, sufficiently reconcileable.

MOCHA, or MOKHA, a town of Arabia Felix, situated near the straits of Babelmandel, and on a bay which is peculiarly adapted for shipping. It is of a circular form, and surrounded with walls of hewn stone. Many of the buildings are of stone, and are very lofty, and the steeples of several mosques are seen at a great distance. Brick houses are the most common; but the humbler classes live in huts formed of wicker work covered with clay. The situation of Mocha is very barren, consisting chiefly of arid sand, with little appearance of vegetation; but its markets are well supplied with every variety of animal food, and the sea affords an abundance of excellent fish. The climate is exceedingly sultry, the heat of winter being not less intense than that of our summer, and rain is of very rare occurrence. Besides coffee, which is the staple commodity, gum, myrrh, and frankincense are the principle articles exported; and a great deal is done by importation. This place has become the emporium for the trade of India to the Red sea. The population, without including the Jews inhabiting the suburbs, has been stated at 18,000. The Arabs of Mocha are characterized as grave, superstitious, and very predatory in their dispositions. Considerable trade is carried on by the English and Dutch companies established here. The most current coin of Mocha is the camassie, from fifty to eighty of which are equivalent to a current dollar; but this is one and a half per cent. less in value than a Spanish dollar.

MODE, in music, a proper disposition of the air and accompaniments relative to certain principal sounds upon which a piece of music is formed. The sounds essential to the mode are, the tonic or key, being the fundamental note both of the tone and the mode; the dominant, which is a fifth from the tonic; and the mediant, which constitutes the mode, and is a third from the same tonic. Because the third may be of two kinds, there are two different modes. The mode is major when the mediant forms a greater third with the tonic, and when the third is lesser it is minor. See MUSIC.

MODEL signifies an original pattern from which a copy is to be taken, and applies more particularly to building. For considerable structures, a model in relievo is much preferable to a draught. Models are of essential use in ship-building, as well as in painting and sculpture. Those in imitation of natural or artificial substances are commonly formed of plaster of Paris and in moulds.

The interesting and accurate model of the mountainous parts of Switzerland, executed by the indefatigable General Pfiffer, is justly celebrated. It is composed of a mixture of charcoal, lime, clay, a little pitch, and a slight coating of wax, and is sufficiently hard to be trod upon without injury. The dimensions are 12½ feet in length, and 12 in breadth, comprehending an extent of country 18½ leagues long, and 12 broad. This model consists of 142 compartments of various sizes, and capable of being separated and replaced with the utmost facility. It was commenced by the general in 1766, when he was fifty-nine years of age; and after great fatigue and even dangerous exposure incurred in its execution, it was completed in 1785. The objects are represented as they exist in nature, and woods of various kinds, strata of rocks, towns, villages, roads, torrents, and even every path, are all distinctly marked.

MODENA, a duchy of Italy, bounded on the west by Parma, on the north by Mantua, on the east by Ferrarese, Bolognese, and Tuscany, and on the south by Lucca, and extending 65 miles in length and 35 in breadth, is productive of corn, wine, oil, and fruits, and abounds in cattle. It is watered chiefly by the rivers Crostolo, Secchia, and Panaro. The ruling family of Este derive their name from a city in the district of Padua, and is ancient.

MODENA, the capital of the duchy of the same name, and a bishop's see, is an ancient populous and fortified city, at the distance of twenty eight miles east from Parma. It contains a magnificent college, a cathedral, and several churches and monasteries, together with the grand ducal palace, which has a rich variety of paintings. The inhabitants of Modena, amounting to 30,000, are chiefly notable for the manufacture of masks, which constitute an article of export.

This much celebrated city fell into the hands of the French in 1796, and became a part of the kingdom of Italy, but was restored to the archduke of Austria in 1814. The government, which is monarchical, is superintended by a regency of conservators. Among the eminent characters to which Modena has given birth are the poet Tasso, the great painter Corregio, and Montecuculi, the imperial general.

MODERATOR, one appointed to preside in any assembly. The term particularly applies to the president of the annual General Assembly of the Church of Scotland, as well as to the presidents of presbyteries and synods.

MODIUS, a Roman dry measure for every sort of grain, containing 32 heminae, or 16 sextarii, or one-third of the amphora, amounting to an English peck.

MOFFAT, a town of Dumfries-shire in Scotland, celebrated for its mineral waters, which are its principal support, consists of one spacious street, and contains an elegant church, an assembly-room, and excellent accommodations for the numerous visitants. It is 50 miles south-west from Edinburgh, and the population is nearly 2000.

MOGADORE, or MOGODORO, a spacious and well fortified town of the kingdom of Morocco, is almost surrounded by the sea, and has a convenient harbour for ordinary vessels. The streets are narrow and in straight lines, and the houses are very regular and elevated. The entrance, both by sea and land, is by means of elegant stone archways, which have double gates. Mogadore contains a handsome market-place, a custom-house, and powder magazine, and the residence of the emperor is a well constructed palace. The foreign trade of the country is almost wholly conducted at this place; and hides, leather, wool, elephants' teeth, gum, olive oil, ostrich feathers, mats, carpeting, and various fruits, are the principal articles exported, while timber, artillery, gunpowder, cloths, lead, and iron bars, hardware, mirrors, tea, and sugar, are among the chief imports. Notwithstanding the great distance from Europe, Mogadore is the only port maintaining a regular commercial intercourse with that quarter of the globe. It is situated 120 miles from Morocco, in west longitude 9° 35′, and north latitude 31° 33′.

MOGULS, a great and celebrated people of Asia, whose conquests were, at one period, the most extraordinary of any on record. Their history being much involved in fable, the origin of the Moguls cannot, with certainty, be deduced; but they themselves claim their descent from Japhet, or Japhis, as they call him, the son of Noah. Their first king or khan, according to their own account, was Turk, the son of Japhet; and the Tartars, therefore, assert that the appellation Turks properly applies to them. To this their first prince they attribute many of their barbarous inventions.

The empire of the Moguls, it was formerly believed, included those parts of Asia over which Tamerlane and his successors reigned prior to the conquest of Hindostan; but in a more restricted sense, and that in which it is now understood, the Mogul empire was that maintained in Hindostan and the Deccan by the descendants of Tamerlane. See HINDOSTAN.

MOHAIR, the hair of a species of goat common in Angora in Turkey, at which place camblets are manufactured of it. These camblets are also denominated mohair, and are of two kinds; the one smooth and plain, the other watered like tabbies. The woof of some camblets is of wool, cotton, or thread.

MOHAWK RIVER, a river of New York, which rises about eight miles from Black or Sable river, connected with lake Ontario, is augmented in its course by several tributary streams, and flows by three mouths into Hudson's river opposite to Lansinburgh and Troy. Three miles above its junction with the Hudson, this river has a cataract where the stream, about 300 yards wide, has a quick descent of 30 feet, and then a perpendicular fall of nearly 40 feet. The Mohawk river is navigable for boats from Skenectady to Utica. Its banks were, at one period, inhabited by Indians called Mohawks, formerly very powerful, and one of the six nations of the Iroquois, who were acknowledged by the other tribes to be "the true old head of the confederacy." They were familiar with the English language, had made considerable progress in civilization, and many of them had embraced the Christian faith. Part of them now reside in Upper Canada, others are settled on the Grand river; but a great number of them, from attachment to the Johnston family, were induced to emigrate with Sir John Johnston to Canada in 1776, and none of them are now in the United States.

MOIRA, a post town of the county of Down in Ireland, situated 69 miles from Dublin and 15 southwest from Belfast, is chiefly remarkable for the linen manufacture, and gives the title of earl to the family of Rawdon.

MOISTURE, a term denoting animal fluids, the juices of plants, or dampness of the air or other bodies.

MOIVRE, ABRAHAM DE, a French mathematician of great note, and born at Vitri in Champagne in 1667. The revocation of the edict of Nantes occasioned his repairing to England, and having previously made some progress in the study of mathematics, he now applied himself still more assiduously to that sublime science, and, with the aid of Newton's Principia, readily attained a perfect knowledge of the geometry of infinites. The conspicuous talents of De Moivre ere long procured him a seat in the Royal Society of London, and in the Royal Academy of Sciences at Paris; and such was the estimation in which he was held by the former, that he was considered qualified to decide between Leibnitz and Newton in the celebrated controversy respecting the differential calculus. In 1738 appeared his treatise on the Doctrine of Chances, which was followed, in 1752, by that on Annuities. Many invaluable papers were contributed by him to the Philosophical Transactions. He lived to the advanced age of 87 years, but was deprived of his sight and hearing some time before his death, which happened at London in 1754.

Besides his eminent attainments in mathematical learning, De Moivre's knowledge in polite literature was very extensive. He was remarkable for solidity and great accuracy, both in his conversation and writings; and so intimately conversant was he with the best authors of antiquity, that he was not unfrequently consulted respecting knotty passages in their works.

MOLASSES, or MOLOSSES, otherwise called treacle, or syrup of sugar, is that gross matter which remains after refining the sugar, and which cannot be brought to a more solid consistency than that of syrup. The poorer classes in Holland use this syrup as a substitute for sugar. A kind of spirit is made from molasses; and it is also used in the preparation of tobacco.

Artificial molasses from apples, without the addition of sugar, is thus made: The apples being ground or pressed, the juice is to be boiled in a large copper till three quarters of it be evaporated, which is effected with a moderate fire in the course of six hours. This new preparation, which appears of the same consistence, taste, and colour as common molasses, besides serving all the ordinary purposes, is useful for preserving cyder and giving it an agreeable colour. Two quarts is sufficient for a barrel of racked cyder.

MOLDAVIA, a province of Turkey in Europe, bounded on the north by Poland, from which it is also separated on the north-east by the Dniester, on the east by New Russia and Bessarabia, on the south by Wallachia, and on the west by Transylvania, is upwards of 240 miles in length, and 150 in breadth, and abounds in corn, wine, and rich pastures, together with horses, cattle, sheep, game, and fish.

The Danube, Dniester, and Pruth, are the chief rivers. Moldavia is inhabited by Christians of the Greek church. Jassy is the principal town. A great part of this province was ceded to Russia by the treaty of 1812.

MOLE, in architecture, a massive work, consisting of large stones laid in the sea, by means of coffer-dams extending before a port, either to defend the harbour from the impetuosity of the waves, or to prevent the passage of vessels without leave. Sometimes the term is applied to the harbour itself.

MOLIERE, (John Baptist Poquelin De,) the much celebrated comic dramatist of France, was born at Paris in 1620. His father, who was an upholsterer, designing him for the same profession, young Poquelin's education was comparatively neglected till his fourteenth year, when, conceiving a remarkable taste for reading, he was, at his own earnest suggestion, sent to the Jesuits' college of Clermont, where he soon gave evidence of peculiar talents. Though subsequently obliged to follow his trade for a time, he, on the death of his father, formed the resolution of indulging his histrionic propensity, and, on that account, assumed the name of Moliere. By his own exertions he was now successful in raising a company at Lyons, which he denominated *The Illustrious Theatre*; and here his first comedy, entitled *l'Etourdi*, was performed in 1653. His *Depit Amoureux* and *Precieuses Ridicules* were next successfully played before the prince of Conti at Beziers. Flushed with encouraging prospects, he afterwards visited Grenoble and Rouen, whence he returned to Paris under the auspices of Gaston duke of Orleans, by whom he was happily introduced to Louis XIV., who, in 1665, employed him in his service, having previously granted him permission to open a theatre in the metropolis. Being thus settled, he soon rose in public estimation by his successive dramatic pieces; and having, about this time, married the daughter of an actress, he is said to have experienced the reality of those matrimonial distresses so amusingly depicted in his comic writings. It is perhaps not unworthy of remark, that Moliere was accustomed to read his productions to an old servant-maid of his own, from the degree of whose laughter at the more comic passages he anticipated how they would be applauded upon the stage. The *Misantrope* of Moliere, which proved a very fortunate piece, is judged to be inferior only to *Tartuffe*, the latter being generally esteemed a masterpiece in the French drama.

The death of this remarkable man was sudden and striking. In his last production, *Le Malade Imaginaire*, he persisted to perform his part notwithstanding extreme indisposition, and thus occasioned the rupture of a blood-vessel, which put a period to his existence in 1653, and in the 63d year of his age. Such was Moliere's state of exhaustion in this his final performance, that when he came to counterfeit *the imaginary sick man* as dead, it was actually supposed he was a corpse; and when, towards the close of the play, he appeared speaking of rhubarb and senna, when consulting the physicians, the blood issued from his mouth.

From the circumstance of Moliere having been by profession a player, and having irritated the clergy by his Tartuffe, it was only through the personal interference of the king that permission was obtained from the archbishop of Paris to bury his remains *privately* in consecrated ground, in a chapel of the parish of St Eustache. On hearing of the refusal of Christian burial to her husband, the widow of Moliere is said to have remarked emphatically, "France grudges a tomb to him to whom Greece would have erected altars!" His funeral was respectfully attended by the populace, and his remains were interred by the light of a hundred flambeaux. Moliere, who assuredly ranks high among modern writers, is, by Voltaire, styled the father of French comedy.

MOLLUSCA. See Helminthology.

MOLOCH, from the Hebrew, signifying *king*, the principal but false god of the Ammonites, and to whom they dedicated their children, by causing them "pass through the fire." According to some, this unnatural consecration was performed by the children leaping over a fire, or passing between two fires; but the general supposition is, that they were really sacrificed in the fire to this god, as was customary with the inhabitants of Sepharvaim. The Pagans, however, were accustomed to lustrate or purify by fire. It appears from Scripture that the Israelites were extremely addicted to the worship of Moloch in the valley of Tophet and Hinnom, to the eastward of Jerusalem. Respecting the relation which Moloch bears to the other Pagan divinities, some have attempted to identify him with Mars or with Mercury, while others take him for the sun or the king of heaven; but the prevalent idea is, that Moloch was the same with Saturn, to whom human sacrifices were offered.

MOLOSSES. See Molasses.

MOLOSSUS, in Greek and Latin poetry, a foot formed of three long syllables; as aūdīrī, cāntābānt, vīrtūtēm. It is so denominated from a favourite march of the Molossi, or from the temple of Jupiter Molossus, odes having been sung there in which this foot was much used and most prevalent.

MOLUCCAS, or Spice Islands, a cluster of islands in the Indian ocean, nearly under the line. Amongst the principal of these are, Amboyna, Ceram, Ternate, Tydor, Machian, and others. These islands, the largest of which does not exceed thirty miles in circuit, abound in oranges, lemons, and other fruits, together with spices, particularly cloves and nutmegs, but afford neither corn nor rice, and have no cattle except goats. Large snakes and land crocodiles are common on these islands; and the birds of Paradise, supposed to come from New Guinea, are so numerous as to constitute an article of traffic. Pearls are said to be occasionally found on the coasts, and the rocks of coral are of great variety and beauty. Two distinct races of inhabitants occupy the Moluccas. These are the Malays, who are Mahometans, and dwell on the coasts, and the Papuas or oriental Negroes in the interior. The men wear a hat of leaves and a covering of cloth round the middle, and the women have remarkably broad hats and a large garment not unlike a sack. The natives elevate their houses on pillars of eight or ten feet in height, and consequently enter them by means of ladders. The Portuguese discovered the Moluccas, and settled on the coast in 1571, but were afterwards superseded by the Dutch. By a treaty, in 1619, the English were to enjoy one-third and the Dutch two-thirds of the produce of them; but the latter were soon after guilty of a most atrocious plot to render themselves masters of the whole.

*Amboyna*, the Dutch metropolis of the Moluccas, has a delightful aspect, and is divided by a bay into two parts; the larger of which is Hetou, and the other Leytimor. The produce consists of cloves, nutmegs, sugar, coffee, and various fruits. Deer and wild hogs frequent the woods; and the domestic animals are beeves, horses, sheep, goats, and hogs. The natives are chiefly Mahomedans, and are peculiarly remarkable for large whiskers. They purchase their wives from their parents; but barrenness renders the marriage void. At the beginning of the 17th century the English and Dutch had factories in this island; but the English were, in 1622, expelled, and many of them most cruelly put to death. Amboyna was taken by the British in 1796, restored in 1802, and retaken in 1810. The chief town is of the same name, and is well built and fortified.

*Ceram* is amongst the largest of the Moluccas, and is mountainous and woody. The sago tree is the chief article of export. This island being occupied by a savage race, little is known of its interior.

*Ternate*, the most important of the proper Moluccas, is about 25 miles in circumference, and produces a great quantity of cloves and other fruits. It is hilly, and the woods afford plenty of game. Goats, deer, and hogs are the animals which are the most numerous. The boa constrictor makes his terrific appearance occasionally. Amongst the beautiful birds of this island may be noticed the king-fisher, which is scarlet and mazarine blue. Ternate is governed by a sultan, whose controul also extends over Machian, Motir, and Mortay, the north part of Gilolo, some of the Celebezian isles, and part of Papua. An alliance formed in 1638, between the sultan of Ternate and the Dutch, has been repeatedly renewed.—*Tydor* is situated ten miles south from this island.—*Machian* is about 20 miles in circuit, and remarkably fertile, producing the best cloves. It rises in a conical form, and contains three inaccessible forts belonging to the Dutch.

MOLYNEUX, Dr William, an eminent mathematician, who was born in Dublin in 1656. Having undergone a regular course of studies at the university of his native city, he removed to London and entered the Inner Temple, where he, for three years, applied himself to the acquisition of law. On his return to Ireland, he married the daughter of Sir William Domville, and about three years afterwards commenced a literary correspondence, which, for several years, subsisted between him and Mr Flamstead, the king's astronomer. In conjunction with Sir William Petty, Dr Molyneux effected the establishment of a Philosophical society in Dublin, in imitation of the Royal society of London. He published his Sciothericum Telescopium in 1689, and afterwards prepared his Dioptrics, which he dedicated to the Royal society. In 1692 he was appointed one of the representatives of Dublin; and, in 1695, was honoured with the degree of L.L.D. Among his literary correspondents, Mr Locke, in particular, appears to have ranked high in his estimation. Dr Molyneux contributed several memoirs to the Philosophical Transactions. He died in 1698.

MOMENT, or Instant, is an indefinitely small portion of time; or it may more consistently be denominated the terminating limit of a portion of time, taken in the same sense as a geometrical line.

MOMENT, Momentum, or Impetus, the quantity of motion in a moving body, is always equal to the quantity of matter multiplied into the velocity; or it may be considered as a rectangle, under the quantity of matter and velocity. See Mechanics.

MOMENTS, Increments, or Infinitesimals. See Fluxions and Mathematics.

MOMUS, in mythology, the son of Nox and Somnus, and god of raillery. Neptune, Vulcan, and Minerva having required his judgment concerning the excellence of their respective performances, he found fault with them all. Neptune was ridiculed for not placing the horns of the bull before his eyes, or in his shoulders, to enable him to give a surer and stronger blow; Minerva for erecting a house not moveable at pleasure, if molested by bad neighbours; Vulcan for not having made man with an aperture or window in the breast, that his thoughts and his treachery might be seen. For such sarcastic remarks upon the gods, Momus was banished from heaven. The image of this god is commonly exhibited holding a small figure in his hand, and raising a mask from his face.

MONA, an island between Britain and Ireland, the Monaæda of Ptolemy, the Monapia or Monabia of Pliny, generally supposed to be the isle of Man; also another island, of greater breadth, on the coast of the Ordovices, an ancient seat of the Druids, mentioned by Tacitus, and now called Anglesey. Mona was the ancient name of Inch-Colm. There is an island in the West Indies near St Domingo, and another in the Baltic, both of which are called Mona.

MONACHISM. See Monastery and Monk.

MONADES, an astronomical term of different acceptations. It sometimes implies digits; and in the Leibnitzian philosophy it denotes things that are indivisible.

MONAGHAN, a county of Ireland, and in the province of Ulster, bounded on the north by Tyrone, on the east by Armagh, on the south by Louth and Cavan, and on the west by Fermanagh, is 32 miles in length and 22 in breadth, and contains 21 parishes. It is boggy in different parts, but in others the soil is favourable for growing flax as well as potatoes and oats. Notwithstanding the exposure to the north-westerly winds, which adds to the natural dampness of the soil, this county is by no means unhealthy. The inhabitants, who are chiefly weavers and farmers, amount to 117,000. This county depends for support on the linen manufacture, and the trade in that article is averaged at about L.200,000 annually. The yarn is spun by women, who are hired out for that purpose. A web of linen, consisting of 20 yards, is said to require three weeks for its completion, and the payment for this is about one pound. A weaver consequently receives only about six shillings and eightpence per week; yet it appears that this small pittance suffices; the weekly expenses for potatoes, herrings, and butter milk, of a manufacturing family of six in number, being commonly about five shillings. Monaghan has six fairs annually, and sends two members to Parliament.

*Monaghan*, the capital, is a market and post town, at the distance of 62 miles from Dublin, and has a castle on the site formerly occupied by a Franciscan monastery, which was founded in 1462. It is an ancient place, and was first called Muinechan.

MONARCHY, from the Greek, signifying *one who governs alone*, applies to a state in which the supreme power is committed to one individual. As dangerous consequences might obviously arise from the sinews of government being knit together and absolutely united in one prince, a democracy seems the proper medium to direct the end of the law, and an aristocracy to provide the means by which that end shall be obtained, while a monarchy is, in the highest degree, adapted for carrying these means into execution. On these principles is founded the excellency of the British constitution. See GOVERNMENT, and ECONOMY POLITICAL.

Four grand or universal monarchies are generally referred to; the Assyrian, Persian, Grecian, and Roman. The Assyrian, founded soon after the flood, is the most ancient; and Belus, by some considered the Nimrod of Scripture, is placed at the head of the series of Assyrian kings. The Persian monarchy continued 200 years from the time of Cyrus, whose reign commenced A. M. 3468, to that of Darius Codomanus, who being conquered by Alexander, the empire was transferred to the Greeks A. M. 3674. Respecting the Grecian monarchy, there having been no successor appointed at the death of Alexander, all the commanders at first assumed the title of viceroys over the states governed by them, and afterwards took the title of kings, when the family of Alexander had become extinct. The Roman monarchy existed 244 years from the building of the city till the abrogation of the royal power.

MONASTERY, a term applied generally to convents or houses devoted to the reception of monks, mendicant friars, or nuns.

The monastic profession commenced in the fourth century, when St Anthony, who, at an early period, became a recluse, having disposed of his possessions, retired from the world, and dwelt on an eminence near the Red sea. About the same period, communities of religious were instituted in Egypt by St Pachomius, though St Basil, from his having prescribed rules of discipline for the monasteries, is considered the great father and patriarch of the eastern monks. St Benedict, who appeared in Italy about the close of the fifth century, was the patron of the western monks. The monastic state being introduced into England by St Augustine in 596, was attended with such wonderful success that, in the course of two centuries, even kings and queens shewed a preference to the religious habit, and likewise ended their days in the monasteries which they had founded.

The houses of the religious which were established in England and Wales were cathedrals, colleges, abbeys, priories, preceptories, commandries, hospitals, friaries, hermitages, chantries, and free chapels, all of which were under the cognizance of certain officers. Between the years 1312 and 1515, the suppression of these houses was gradually going on; and, subsequently to the latter period, the colleges of Oxford and Ipswich were endowed, through the medium of Cardinal Wolsey, who, for that purpose, procured a dissolution of upwards of thirty religious houses. This celebrated cardinal also obtained a bull from the Pope to dissolve monasteries not containing above six monks, to the annual value of 8000 ducats, for the endowment of Windsor and King's college in Cambridge. By two bulls granted to Cardinals Wolsey and Campeius, monasteries of less than twelve monks were to be annexed to greater ones; and, by another, they were authorized to inquire about abbeys to be converted into cathedrals.

Among the various causes of the dissolution of the monasteries, the impious behaviour of the monks, together with their supposed attachment to the supremacy of the Pope, had a powerful effect. To this, likewise, the unguarded opposition evinced by the observant friars in respect of the king's divorce from Queen Catherine essentially contributed. Wolsey and others were actuated in the suppression of them by the desire of promoting learning, while Archbishop Cranmer's motive for interference was the commendable design of accelerating the reformation. But the most efficient occasion of dissolving these houses was King Henry's want of a supply, and the natural disposition of the people to save their money. Accordingly, a motion was brought forward in Parliament, that, in order to support the king's state, all the religious houses might be conferred upon the crown which were not able to spend above L.200 a-year. By this act (27 Hen. VIII. c. 28.) 380 houses were dissolved, and a revenue of from L.30,000 to L.32,000 per annum, besides about L.100,000 value in plate and jewels, thus fell to the crown. The temporary disturbance incident to this determined procedure being appeased, the appointment of a new visitation by the king occasioned the surrender of the greater abbeys; and, by 31 Hen. VIII. c. 13. it was enacted, that all monasteries, &c. which have been surrendered since the fourth of February in the 27th year of his reign, and which hereafter shall be surrendered, shall be vested in the king. A succeeding act likewise suppressed the knights of St John of Jerusalem. The king's revenue by these two acts was augmented L.100,000 a-year, not including a considerable sum in plate and jewels. By 37 Hen. VIII. c. 4. for dissolving colleges, free chapels, chantries, &c. which act was farther enforced by 1 Edw. VI. c. 14., no less than 90 colleges, 110 hospitals, and 2374 chantries and free chapels were suppressed. This was the last act of dissolution in the reign of Henry VIII. From first to last, it has been stated, that the number of houses and places suppressed, independent of those of inferior note, amounted to 3182; the total revenue arising from which has been estimated at L.140,784, 19s. 3¾d., besides a vast quantity of silver plate. The houses suppressed are said to have contained 50,000 individuals.

By means of what Henry VIII. received of these great revenues, he founded the new bishopricks of Westminster, Peterborough, Chester, Gloucester, Bristol, and Oxford. In eight other sees he founded deaneries and chapters, by converting the priors and monks into deans and prebendaries, viz. Canterbury, Winchester, Durham, Worcester, Rochester, Norwich, Ely, and Carlisle. The colleges of Christ church in Oxford and Trinity in Cambridge, were also founded, and King's college, Cambridge, was finished. Likewise professorships of law, divinity, physic, and of the Hebrew and Greek languages, were instituted in both the universities; and besides the great sums expended in building and fortifying the forts in the Channel, a perpetual pension was granted to the poor knights of Windsor; and St Bartholomew's hospital and the house of Greyfriars was bestowed on the city of London. In conclusion, it may be remarked, that this suppression of monasteries was not an act of the church but of the state, though the pope himself contributed towards it, in the first place, through the medium of his bulls and licences.

MONBODDO, JAMES BURNET, Lord, was descended of an ancient family in Kincardineshire, and born in 1714. Having prosecuted the study of the law, and been admitted a member of the faculty of Advocates in 1737, he was, in 1767, elected one of the Senators of the College of Justice. His work on the Origin and Progress of Language gave striking evidence of the fervour with which his lordship regarded the learning and wisdom of the ancients, and the comparative contempt he entertained for the moderns; and it was consequently not received by the critics with the most pleasurable sensations. Almost all the Scottish literati, indeed, concurred in condemning the work as ridiculous and absurd. But his next production, "Ancient Metaphysics," met a very different reception with the public. The design of this work was to vindicate the ancients and the principles of the Grecian philosophy in a satisfactory manner. He died in 1799.

MONASTIC applies to any thing connected with the monastic life. The monastic profession being a kind of civil death, it has a similar effect, in respect of all worldly concerns, as a natural death.

MONDAY, the second day of the week, is so called from having been anciently sacred to the moon, or to Mona, the Diana of the Saxons.

MONEY, a circulating medium, by means of which commercial intercourse is facilitated. It is divided nto real or effective, and imaginary, or money of account. All current coins of gold, silver, copper, or other metal, constitute real money; whereas imaginary money, such as pounds in England, is not supposed to exist in specie, and is consequently an invention for keeping accounts with convenience and accuracy. Before the introduction of money, the system of traffic among men consisted wholly in bartering or exchanging different commodities; but in the course of time it was found by experience, that, for the sake of communicative justice, some measure or standard should be established, by which to ascertain the comparative value of things. Some infer, from Josephus, that this invention first originated with Cain; but be that as it may, the first occurrence of the kind that we read of is that of Abraham paying four hundred shekels for a burying-place. The era of the invention of money cannot be decidedly settled; but both gold and silver money were probably current in Egypt at an early period, and being thence communicated to Greece, were afterwards introduced into all the Roman provinces.

It is obvious that metals are peculiarly well adapted for coins, and that coins must rise or fall in value according to the greater or lesser abundance of the precious metals. Thus the acquisition to Europe of a thousand million of bullion from America, within the period of three centuries, occasions a greater sum to be paid now for commodities than was necessary about a century ago; but any diminution in the quantity of gold or silver would occasion a proportionate rise in value.

Besides metals, other substances have been applied to the purposes of money. Seneca informs us, that stamped money of leather was anciently in use. Money of this kind was authorised by Frederick II. at the siege of Milan; and the Dutch, in 1574, used coins of pasteboard. Iron rings, or plates, passed as money with the ancient Britons, and iron bars with the Lacedæmonians.

Different forms and impressions have been given to coins. The shekel of the Jews had on one side the golden pot which held the manna and on the other Aaron's rod. The coins of the Dardans bore the stamp of two cocks fighting, and the stamp of an owl or an ox was common with the Athenians. Previous to the fall of the commonwealth, the coins of the Romans sometimes bore the images of remarkable men deceased, but they afterwards were impressed with the emperor's head,—a practice which, excepting with the Turks and Mahometans, has obtained in all civilized countries. Coins in Great Britain are round, in Spain they are multangular or irregular, and in the Indies they are square or nearly globular. When the Romans settled in this island, the Britons caught the idea of stamping their gold and silver coins with the images of their kings; but these coins were afterwards superseded by the Roman coins, which continued current about 500 years.

The most ancient English coin, if we follow the opinion of Mr Camden, was that of Ethelbert, king of Kent, the first prince who in Britain embraced the Christian faith. It was during his reign that money-accounts began to pass by the names of pounds, shillings, pence, and mancuses. Pence, from the Latin *pecunia*, or from *pendo*, were worth about threepence of our money; five of these were equal to the schilling, and forty schillings made a pound. The pence being the only real money, thirty of them made a mancus, which again was reckoned both in gold and silver, and supposed by some to be the same as a mark. A system of reckoning by ores, *per oras*, according to Doomsday-book, was introduced by the Danes, and twenty of these ores are supposed to have been equal to two marks.

Money coined in the east parts of Germany was, in the time of Richard I. much esteemed in England, and called Easterling money, the inhabitants of those parts being distinguished as Easterlings.—

Thus the name *Sterling* came afterwards to be applied to the coin in an improved state. A certain standard for the coin was first appointed by Edward I. It is stated as follows by Greg. Rockley, mayor of London, and mint-master: "A pound of money containeth twelve ounces: in a pound there ought to be eleven ounces, two easterlings, and one farthing; the rest alloy. The said pound ought to weigh twenty shillings and threepence in account and weight. The ounce ought to weigh twentypence, and a penny twenty-five grains and a half. Note, that eleven ounces two pence Sterling ought to be of pure silver, called leaf silver; and the minter must add of other weight seventeenpence halfpenny farthing, if the silver be so pure." The coining of gold was first begun by the states of Europe in 1320. Edward III. at this time coined the pieces which were denominated florence, from being coined by Florentines. These were followed by nobles, then rose-nobles, current at 6s. 8d., half-nobles, called half pennies, at 3s. 4d. and quarters at 20d. called farthings of gold. Succeeding kings coined rose-nobles and double rose-nobles, great sovereigns, and half Henry nobles, angels, and shillings. By James I. were coined units, double crowns, Britain crowns, &c. In the reign of Charles II. were first coined guineas and half-guineas.

A perspicuous view of the monies of different parts of the world is contained in the following table.

## UNIVERSAL TABLE

### OF THE PRESENT STATE OF THE REAL AND IMAGINARY MONIES OF THE WORLD.

**† This mark is prefixed to the Imaginary Money, or Money of Account.**

**All Fractions in the Value English are Parts of a Penny.**

### EUROPE—NORTHERN PARTS.

#### ENGLAND AND SCOTLAND.

*London, Bristol, Liverpool, Edinburgh, Glasgow, Aberdeen, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| | A Farthing | 0 | 0 | $0\frac{1}{4}$ |
| 2 | Farthings = a Halfpenny | 0 | 0 | $0\frac{1}{2}$ |
| 2 | Halfpence a Penny | 0 | 0 | 1 |
| 4 | Pence a Groat | 0 | 0 | 4 |
| 6 | Pence a Half Shilling | 0 | 0 | 6 |
| 12 | Pence a Shilling | 0 | 1 | 0 |
| 5 | Shillings a Crown | 0 | 5 | 0 |
| 20 | Shillings †a Pound Sterling. | 1 | 0 | 0 |
| 21 | Shillings a Guinea | 1 | 1 | 0 |

#### IRELAND.

*Dublin, Cork, Londonderry, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| | A Farthing | 0 | 0 | $0\frac{3}{13}$ |
| 2 | Farthings = a Halfpenny | 0 | 0 | $0\frac{6}{13}$ |
| 2 | Halfpence †a Penny | 0 | 0 | $0\frac{12}{13}$ |
| $6\frac{1}{2}$ | Pence a Half Shilling | 0 | 0 | 6 |
| 12 | Pence †a Shilling Irish | 0 | 0 | $11\frac{3}{40}$ |
| 13 | Pence a Shilling | 0 | 1 | 0 |
| 65 | Pence a Crown | 0 | 5 | 0 |
| 20 | Shillings †a Pound Irish | 0 | 18 | $5\frac{1}{2}$ |
| $23\frac{3}{4}$ | Shillings a Guinea | 1 | 1 | 0 |

#### FLANDERS AND BRABANT.

*Ghent, Ostend, &c. Antwerp, Brussels, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| † | A Pening | 0 | 0 | $0\frac{9}{100}$ |
| 4 | Peningens = an Urche | 0 | 0 | $0\frac{9}{40}$ |
| 8 | Peningens †a Grote | 0 | 0 | $0\frac{9}{20}$ |
| 2 | Grotes a Petard | 0 | 0 | $0\frac{9}{10}$ |
| 6 | Petards †a Scalin | 0 | 0 | $5\frac{2}{5}$ |
| 7 | Petards a Scalin | 0 | 0 | $6\frac{3}{10}$ |
| 40 | Grotes †a Florin | 0 | 1 | 6 |
| $17\frac{1}{2}$ | Scalins a Ducat | 0 | 9 | 3 |
| 240 | Grotes †a Pound Flemish. | 0 | 9 | 0 |

#### HOLLAND AND ZEALAND.

*Amsterdam, Rotterdam, Middleburg, Flushing, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| † | A Pening | 0 | 0 | $0\frac{21}{320}$ |
| 8 | Peningens = †a Grote | 0 | 0 | $0\frac{21}{40}$ |
| 2 | Grotes a Stiver | 0 | 0 | $1\frac{1}{20}$ |
| 6 | Stivers a Scalin | 0 | 0 | $6\frac{3}{10}$ |
| 20 | Stivers a Guilder | 0 | 1 | 9 |
| 50 | Stivers a Rix-Dollar | 0 | 4 | $4\frac{1}{4}$ |
| 60 | Stivers a Dry Guilder | 0 | 5 | 3 |
| 105 | Stivers a Ducat | 0 | 9 | 3 |
| 6 | Guilders †a Pound Flemish. | 0 | 10 | 6 |

#### GERMANY.

HAMBURGH. *Altena, Lubec, Bremen, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| † | A Tryling | 0 | 0 | $0\frac{3}{128}$ |
| 2 | Trylings = †a Sexling | 0 | 0 | $0\frac{3}{64}$ |
| 2 | Sexlings a Fening | 0 | 0 | $0\frac{3}{32}$ |
| 12 | Fenings a Schilling Lub. | 0 | 0 | $1\frac{1}{8}$ |
| 16 | Schills. Lub. † a Marc | 0 | 1 | 6 |
| 2 | Marcs a Slet Dollar | 0 | 3 | 0 |
| 3 | Marcs a Rix-Dollar | 0 | 4 | 6 |
| $6\frac{1}{4}$ | Marcs a Ducat | 0 | 9 | $4\frac{1}{2}$ |
| 120 | Schillings †a Pound Flemish. | 0 | 11 | 3 |

HANOVER. *Lunenburgh, Zell, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| † | A Fening | 0 | 0 | $0\frac{7}{48}$ |
| 3 | Fenings = †a Dreyer | 0 | 0 | $0\frac{7}{16}$ |
| 8 | Fenings a Marien | 0 | 0 | $1\frac{1}{6}$ |
| 12 | Fenings a Grosh | 0 | 0 | $1\frac{3}{4}$ |
| 8 | Groshen a Half Gulden | 0 | 1 | 2 |
| 16 | Groshen a Gulden | 0 | 2 | 4 |
| 24 | Groshen †a Rix-Dollar | 0 | 3 | 6 |
| 32 | Groshen †a Double Gulden | 0 | 4 | 8 |
| 4 | Guldens a Ducat | 0 | 9 | 2 |

Money.

### SAXONY AND HOLSTEIN.

*Dresden, Leipsic, &c. Wismar, Keil, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| † | An Heller | 0 | 0 | $0\frac{7}{96}$ |
| 2 | Hellers = a Fening | 0 | 0 | $0\frac{7}{16}$ |
| 16 | Hellers a Marien | 0 | 0 | $1\frac{1}{6}$ |
| 12 | Fenings a Grosh | 0 | 0 | $1\frac{3}{4}$ |
| 16 | Groshen a Gould | 0 | 2 | 4 |
| 24 | Groshen †a Rix-Dollar | 0 | 3 | 6 |
| 32 | Groshen a Specie Dollar | 0 | 4 | 8 |
| 4 | Goulds a Ducat | 0 | 9 | 4 |

### BRANDENBURGH AND POMERANIA.

*Berlin, Potsdam, &c. Stetin, &c.*

| | | | | |
|---|---|---|---|---|
| † | A Denier | 0 | 0 | $0\frac{2}{275}$ |
| 9 | Deniers = a Polchen | 0 | 0 | $0\frac{7}{36}$ |
| 18 | Deniers a Grosh | 0 | 0 | $0\frac{7}{13}$ |
| 3 | Polchens an Abras | 0 | 0 | $0\frac{7}{16}$ |
| 20 | Groshen †a Marc | 0 | 0 | $9\frac{1}{3}$ |
| 30 | Groshen a Florin | 0 | 1 | 2 |
| 90 | Groshen †a Rix-Dollar | 0 | 3 | 6 |
| 108 | Groshen an Albertus | 0 | 4 | 2 |
| 8 | Florins a Ducat | 0 | 9 | 4 |

### COLOGN. *Mentz, Triers, Liege, Munich, Munster, Paderborn, &c.*

| | | | | |
|---|---|---|---|---|
| | A Dute | 0 | 0 | $0\frac{7}{80}$ |
| 3 | Dutes = a Cruitzer | 0 | 0 | $0\frac{21}{80}$ |
| 2 | Cruitzers an Albus | 0 | 0 | $0\frac{21}{40}$ |
| 8 | Dutes a Stiver | 0 | 0 | $0\frac{7}{10}$ |
| 3 | Stivers a Plapert | 0 | 0 | $2\frac{1}{10}$ |
| 4 | Plaperts a Copstuck | 0 | 0 | $8\frac{2}{5}$ |
| 40 | Stivers a Guilder | 0 | 2 | 4 |
| 2 | Guilders a Hard Dollar | 0 | 4 | 8 |
| 4 | Guilders a Ducat | 0 | 9 | 4 |

### BOHEMIA, SILESIA, AND HUNGARY.

*Prague, Breslaw, Presburg, &c.*

| | | | | |
|---|---|---|---|---|
| | A Fening | 0 | 0 | $0\frac{7}{60}$ |
| 2 | Fenings = a Dreyer | 0 | 0 | $0\frac{3}{40}$ |
| 3 | Fenings a Grosh | 0 | 0 | $0\frac{7}{20}$ |
| 4 | Fennings a Cruitzer | 0 | 0 | $0\frac{7}{15}$ |
| 2 | Cruitzers a White Grosh | 0 | 0 | $0\frac{14}{15}$ |
| 60 | Cruitzers a Gould | 0 | 2 | 4 |
| 90 | Cruitzers †a Rix-Dollar | 0 | 3 | 6 |
| 2 | Goulds a Hard Dolar | 0 | 4 | 8 |
| 4 | Goulds a Ducat | 0 | 9 | 0 |

### AUSTRIA AND SUABIA.

*Vienna, Triest, &c. Augsburg, Blenheim, &c.*

| | | | | |
|---|---|---|---|---|
| | A Fening | 0 | 0 | $0\frac{7}{60}$ |
| 2 | Fenings = a Dreyer | 0 | 0 | $0\frac{7}{30}$ |
| 4 | Fenings a Cruitzer | 0 | 0 | $0\frac{7}{15}$ |
| 14 | Fenings a Grosh | 0 | 0 | $1\frac{19}{49}$ |
| 4 | Cruitzers a Batzen | 0 | 0 | $1\frac{13}{15}$ |
| 15 | Batzen a Gould | 0 | 2 | 4 |
| 90 | Cruitzers †a Rix-Dollar | 0 | 3 | 6 |
| 30 | Batzen a Specie Dollar | 0 | 4 | 8 |
| 60 | Batzen a Ducat | 0 | 9 | 4 |

Money.

### FRANCONIA. *Frankfort, Nuremberg, Dettingen, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| | A Fening | 0 | 0 | $0\frac{7}{60}$ |
| 4 | Fenings = a Cruitzer | 0 | 0 | $0\frac{7}{15}$ |
| 3 | Cruitzers a Keyser Grosh | 0 | 0 | $1\frac{2}{5}$ |
| 4 | Cruitzers a Batzen | 0 | 0 | $1\frac{13}{15}$ |
| 15 | Cruitzers an Ourt Gould | 0 | 0 | 7 |
| 60 | Cruitzers a Gould | 0 | 2 | 4 |
| 90 | Cruitzers †a Rix-Dollar | 0 | 3 | 6 |
| 2 | Goulds a Hard Dollar | 0 | 4 | 8 |
| 240 | Cruitzers a Ducat | 0 | 9 | 4 |

### POLAND AND PRUSSIA.

*Cracow, Warsaw, &c. Dantzic, Coningsberg, &c.*

| | | | | |
|---|---|---|---|---|
| | A Shelon | 0 | 0 | $0\frac{7}{45}$ |
| 3 | Shelons = a Grosh | 0 | 0 | $0\frac{7}{15}$ |
| 5 | Groshen a Coustic | 0 | 0 | $2\frac{1}{3}$ |
| 3 | Coustics a Tinse | 0 | 0 | 7 |
| 18 | Groshen an Ort | 0 | 0 | $8\frac{2}{5}$ |
| 30 | Groshen a Florin | 0 | 1 | 2 |
| 90 | Groshen †a Rix-Dollar | 0 | 3 | 6 |
| 8 | Florins a Ducat | 0 | 9 | 4 |
| 5 | Rix Dollars a Frederic d'Or | 0 | 17 | 6 |

### LIVONIA.

*Riga, Revel, Narva, &c.*

| | | | | |
|---|---|---|---|---|
| | A Blacken | 0 | 0 | $0\frac{7}{90}$ |
| 6 | Blackens = a Grosh | 0 | 0 | $0\frac{7}{15}$ |
| 9 | Blackens a Vording | 0 | 0 | $0\frac{7}{10}$ |
| 2 | Groshen a Whiten | 0 | 0 | $0\frac{14}{15}$ |
| 6 | Groshen a Marc. | 0 | 0 | $2\frac{4}{5}$ |
| 30 | Groshen a Florin | 0 | 1 | 2 |
| 90 | Groshen †a Rix-Dollar | 0 | 3 | 6 |
| 108 | Groshen a Albertus | 0 | 4 | $2\frac{6}{15}$ |
| 64 | Whitens a Copperplate dollar | 0 | 5 | 0 |

### DENMARK, ZEALAND, AND NORWAY.

*Copenhagen, Sound, &c. Bergen, Drontheim, &c.*

| | | | | |
|---|---|---|---|---|
| | A Skilling | 0 | 0 | $0\frac{9}{16}$ |
| 6 | Skillings = a Duggen | 0 | 0 | $3\frac{3}{8}$ |
| 16 | Skillings †a Marc | 0 | 0 | 9 |
| 20 | Skillings a Rix-Marc | 0 | 0 | $11\frac{1}{4}$ |
| 24 | Skillings a Rix-Ort | 0 | 1 | $1\frac{1}{2}$ |
| 4 | Marcs a Crown | 0 | 3 | 0 |
| 6 | Marcs a Rix-Dollar | 0 | 4 | 6 |
| 11 | Marcs a Ducat | 0 | 8 | 3 |
| 14 | Marcs a Hatt Ducat | 0 | 10 | 6 |

### SWEDEN AND LAPLAND.

*Stockholm, Upsal, &c. Thorn, &c.*

| | | | | |
|---|---|---|---|---|
| † | A Runstick | 0 | 0 | $0\frac{7}{36}$ |
| 2 | Runsticks = a Stiver | 0 | 0 | $0\frac{7}{18}$ |
| 8 | Runsticks a Copper Marc | 0 | 0 | $1\frac{5}{9}$ |
| 3 | Copper Marcs a Silver Marc | 0 | 0 | $4\frac{2}{3}$ |
| 4 | Copper Marcs a Copper Dollar | 0 | 0 | $6\frac{2}{9}$ |
| 9 | Copper Marcs a Caroline | 0 | 1 | 2 |
| 3 | Copper dollars a Silver Dollar | 0 | 1 | $6\frac{2}{3}$ |
| 3 | Silver Dollars a Rix-Dollar | 0 | 4 | 8 |
| 2 | Rix Dollars a Ducat | 0 | 9 | 4 |

Money.

### RUSSIA AND MUSCOVY.

#### *Petersburgh, Archangel, &c. Moscow, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| A | Polusca | 0 | 0 | 0$\frac{27}{200}$ |
| 2 | Poluscas = a Denusca | 0 | 0 | 0$\frac{27}{100}$ |
| 2 | Denuscas † a Copec | 0 | 0 | 0$\frac{27}{50}$ |
| 3 | Copecs a Altin | 0 | 0 | 1$\frac{31}{50}$ |
| 10 | Copecs a Grievener | 0 | 0 | 5$\frac{2}{5}$ |
| 25 | Copecs a Polpotin | 0 | 1 | 1$\frac{1}{2}$ |
| 50 | Copecs a Poltin | 0 | 2 | 3 |
| 100 | Copecs a Ruble | 0 | 4 | 6 |
| 2 | Rubles a Xervonitz | 0 | 9 | 0 |

## EUROPE—SOUTHERN PARTS.

### SWITZERLAND.

#### BASIL. *Zurich, Zug, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| A | Rap | 0 | 0 | 0$\frac{1}{24}$ |
| 3 | Rapen = a Fening | 0 | 0 | 0$\frac{1}{8}$ |
| 4 | Fenings a Cruitzer | 0 | 0 | 0$\frac{1}{2}$ |
| 12 | Fenings † a Sol | 0 | 0 | 1$\frac{1}{2}$ |
| 15 | Fenings a Coarse Batzen | 0 | 0 | 1$\frac{7}{8}$ |
| 18 | Fenings a Good Batzen | 0 | 0 | 2$\frac{1}{4}$ |
| 20 | Sols † a Livre | 0 | 2 | 6 |
| 60 | Cruitzers a Gulden | 0 | 2 | 6 |
| 108 | Cruitzers a Rix-Dollar | 0 | 4 | 6 |

#### ST GALL. *Apenzel, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| An | Heller | 0 | 0 | 0$\frac{1}{16}$ |
| 2 | Hellers = a Fening | 0 | 0 | 0$\frac{1}{8}$ |
| 4 | Fenings a Cruitzer | 0 | 0 | 0$\frac{1}{2}$ |
| 12 | Fenings † a Sol | 0 | 0 | 1$\frac{1}{2}$ |
| 4 | Cruitzers a Coarse Batzen | 0 | 0 | 2 |
| 5 | Cruitzers a Good Batzen | 0 | 0 | 2$\frac{1}{2}$ |
| 20 | Sols † a Livre | 0 | 2 | 6 |
| 60 | Cruitzers a Gould | 0 | 2 | 6 |
| 102 | Cruitzers a Rix-Dollar | 0 | 4 | 3 |

#### BERN. *Lucerne, Neufchatel, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| A | Denier | 0 | 0 | 0$\frac{1}{16}$ |
| 4 | Deniers = a Cruitzer | 0 | 0 | 0$\frac{2}{5}$ |
| 3 | Cruitzers † a Sol | 0 | 0 | 1$\frac{1}{5}$ |
| 4 | Cruitzers a Plapert | 0 | 0 | 1$\frac{3}{5}$ |
| 5 | Cruitzers a Gross | 0 | 0 | 2 |
| 6 | Cruitzers a Batzen | 0 | 0 | 2$\frac{2}{5}$ |
| 20 | Sols † a Livre | 0 | 2 | 0 |
| 75 | Cruitzers a Gulden | 0 | 2 | 6 |
| 125 | Cruitzers a Crown | 0 | 4 | 6 |

#### GENEVA. *Pekay, Bonne, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| A | Denier | 0 | 0 | 0$\frac{1}{32}$ |
| 2 | Deniers = a Denier current | 0 | 0 | 0$\frac{1}{16}$ |
| 12 | Deniers a Small Sol | 0 | 0 | 0$\frac{3}{8}$ |
| 12 | Deniers curt. a Sol current | 0 | 0 | 0$\frac{3}{4}$ |
| 12 | Small Sols † a Florin | 0 | 0 | 4$\frac{1}{2}$ |
| 20 | Sols current † a Livre current | 0 | 1 | 3 |
| 10$\frac{1}{2}$ | Florins a Patacoon | 0 | 3 | 11$\frac{1}{4}$ |
| 15$\frac{3}{4}$ | Florins a Croisade | 0 | 5 | 10$\frac{7}{8}$ |
| 24 | Florins a Ducat | 0 | 9 | 0 |

Money.

### FRANCE.

#### *Lisle, Cambray, Valenciennes, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| A | Denier | 0 | 0 | 0$\frac{1}{24}$ |
| 12 | Deniers = a Sol | 0 | 0 | 0$\frac{1}{2}$ |
| 15 | Deniers † a Patard | 0 | 0 | 0$\frac{5}{6}$ |
| 15 | Patards † a Piette | 0 | 0 | 9$\frac{3}{8}$ |
| 20 | Sols a Livre Tournois | 0 | 0 | 10 |
| 20 | Patards † a Florin | 0 | 1 | 0$\frac{1}{2}$ |
| 60 | Sols an Ecu of Ex. | 0 | 2 | 6 |
| 10$\frac{1}{2}$ | Livres a Ducat | 0 | 9 | 3 |
| 24 | Livres a Louis d'Or | 1 | 0 | 0 |

#### *Dunkirk, St Omers, St Quintin, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| A | Denier | 0 | 0 | 0$\frac{1}{24}$ |
| 12 | Deniers = a Sol | 0 | 0 | 0$\frac{1}{2}$ |
| 15 | Deniers † a Patard | 0 | 0 | 0$\frac{5}{6}$ |
| 15 | Sols † a Piette | 0 | 0 | 7$\frac{1}{2}$ |
| 20 | Sols † a Livre Tournois | 0 | 0 | 10 |
| 3 | Livres an Ecu of Ex. | 0 | 2 | 6 |
| 24 | Livres a Louis d'Or | 1 | 0 | 6 |
| 24$\frac{1}{2}$ | Livres a Guinea | 1 | 1 | 0 |
| 30$\frac{3}{8}$ | Livres a Moeda | 1 | 7 | 0 |

#### *Paris, Lyons, Marseilles, &c. Bourdeaux, Bayonne, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| A | Denier | 0 | 0 | 0$\frac{1}{24}$ |
| 3 | Deniers = a Liard | 0 | 0 | 0$\frac{1}{8}$ |
| 2 | Liards a Dardene | 0 | 0 | 0$\frac{1}{4}$ |
| 12 | Deniers a Sol | 0 | 0 | 0$\frac{1}{2}$ |
| 20 | Sols † a Livre Tournois | 0 | 0 | 10 |
| 60 | Sols an Ecu of Ex. | 0 | 2 | 6 |
| 6 | Livres an Ecu | 0 | 5 | 0 |
| 10$\frac{1}{2}$ | Livres † a Pistole | 0 | 8 | 4 |
| 24 | Livres a Louis d'Or | 1 | 0 | 0 |

### PORTUGAL.

#### *Lisbon, Oporto, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| † A | Re | 0 | 0 | 0$\frac{27}{400}$ |
| 10 | Rez = a Half Vintin | 0 | 0 | 0$\frac{27}{40}$ |
| 20 | Rez. a Vintin | 0 | 0 | 1$\frac{7}{20}$ |
| 5 | Vintins a Testoon | 0 | 0 | 6$\frac{3}{4}$ |
| 4 | Testoons a Crusade of Ex. | 0 | 2 | 3 |
| 24 | Vintins a New Crusade | 0 | 2 | 8$\frac{2}{5}$ |
| 10 | Testoons † a Milre | 0 | 5 | 7$\frac{1}{2}$ |
| 48 | Testoons a Moidore | 1 | 7 | 0 |
| 64 | Testoons a Joannes | 1 | 16 | 0 |

### SPAIN AND CATALONIA.

#### *Madrid, Cadiz, Seville, &c. New Plate.*

| | | L. | s. | d. |
|---|---|---|---|---|
| A | Maravedie | 0 | 0 | 0$\frac{45}{272}$ |
| 2 | Maravedies = a Quartil | 0 | 0 | 0$\frac{45}{136}$ |
| 54 | Maravedies a Rial | 0 | 0 | 5$\frac{3}{8}$ |
| 2 | Rials a Pistarine | 0 | 0 | 10$\frac{3}{4}$ |
| 8 | Rials † a Piastre of Ex. | 0 | 3 | 7 |
| 10 | Rials a Dollar | 0 | 4 | 6 |
| 375 | Maravedies † a Ducat of Ex. | 0 | 4 | 11$\frac{1}{2}$ |
| 32 | Rials † a Pistole of Ex. | 0 | 14 | 4 |
| 36 | Rials a Pistole | 0 | 16 | 9 |

### *Gibraltar, Malaga, Denia, &c. Velon.*

| | | L. | s. | d. |
|---|---|---|---|---|
| † A | Maravedie | 0 | 0 | $0\frac{23}{272}$ |
| 2 | Maravedies = an Ochavo | 0 | 0 | $0\frac{23}{136}$ |
| 4 | Maravedies a Quartil | 0 | 0 | $0\frac{23}{68}$ |
| 34 | Maravedies †a Rial Velon | 0 | 0 | $2\frac{7}{8}$ |
| 15 | Rials †a Piastre of Ex. | 0 | 3 | 7 |
| 512 | Maravedies a Piastre | 0 | 3 | 7 |
| 60 | Rials †a Pistole of Ex. | 0 | 14 | 4 |
| 2048 | Maravedies a Pistole of Ex. | 0 | 14 | 4 |
| 70 | Rials a Pistole | 0 | 16 | 9 |

### *Barcelona, Saragossa, Valencia, &c. Old Plate.*

| | | L. | s. | d. |
|---|---|---|---|---|
| A | Maravedie | 0 | 0 | $0\frac{27}{128}$ |
| 16 | Maravedies = a Soldo | 0 | 0 | $3\frac{3}{8}$ |
| 2 | Soldos a Rial Old Plate | 0 | 0 | $6\frac{3}{4}$ |
| 16 | Soldos †a Dollar | 0 | 4 | 6 |
| 20 | Soldos †a Libra | 0 | 5 | $7\frac{1}{2}$ |
| 21 | Soldos †a Ducat | 0 | 5 | $10\frac{7}{8}$ |
| 22 | Soldos †a Ducat | 0 | 6 | $2\frac{1}{4}$ |
| 24 | Soldos †a Ducat | 0 | 6 | 9 |
| 60 | Soldos a Pistole | 0 | 16 | 9 |

## ITALY.

### GENOA. *Novi, &c.* CORSICA. *Bastia, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| A | Denari | 0 | 0 | $0\frac{43}{1200}$ |
| 12 | Denari = a Soldi | 0 | 0 | $0\frac{43}{100}$ |
| 4 | Soldi a Chevalet | 0 | 0 | $1\frac{18}{25}$ |
| 20 | Soldi †a Lire | 0 | 0 | $8\frac{3}{5}$ |
| 30 | Soldi a Testoon | 0 | 1 | $0\frac{9}{10}$ |
| 5 | Lires a Croisade | 0 | 3 | 7 |
| 115 | Soldi †a Pezzo of Ex. | 0 | 4 | 2 |
| 6 | Testoons a Genouine | 0 | 6 | 2 |
| 20 | Lires a Pistole | 0 | 14 | 4 |

## PIEDMONT, SAVOY, AND SARDINIA.

### *Turin, Chamberry, Cagliari, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| A | Denari | 0 | 0 | $0\frac{1}{16}$ |
| 3 | Denari = a Quatrini | 0 | 0 | $0\frac{3}{16}$ |
| 12 | Denari a Soldi | 0 | 0 | $0\frac{3}{4}$ |
| 12 | Soldi †a Florin | 0 | 0 | 9 |
| 20 | Soldi †a Lire | 0 | 1 | 3 |
| 6 | Florins a Scudi | 0 | 4 | 6 |
| 7 | Florins a Ducatoon | 0 | 5 | 3 |
| 13 | Lires a Pistole | 0 | 16 | 3 |
| 16 | Lires a Louis d'Or | 1 | 0 | 0 |

### *Milan, Modena, Parma, Pavia, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| A | Denari | 0 | 0 | $0\frac{3}{82}$ |
| 3 | Denari = a Quatrini | 0 | 0 | $0\frac{9}{82}$ |
| 12 | Denari a Soldi | 0 | 0 | $0\frac{18}{41}$ |
| 20 | Soldi †a Lire | 0 | 0 | $8\frac{32}{41}$ |
| 115 | Soldi a Scudi current | 0 | 4 | $2\frac{1}{2}$ |
| 117 | Soldi †a Scudi of Ex. | 0 | 4 | 3 |
| 6 | Lires a Philip | 0 | 4 | $4\frac{1}{2}$ |
| 22 | Lires a Pistole | 0 | 16 | 0 |
| 23 | Lires a Spanish Pistole | 0 | 16 | 9 |

### *Leghorn, Florence, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| A | Denari | 0 | 0 | $0\frac{5}{144}$ |
| 4 | Denari = a Quatrini | 0 | 0 | $0\frac{5}{36}$ |
| 12 | Denari a Soldi | 0 | 0 | $0\frac{5}{12}$ |
| 5 | Quatrini a Craca | 0 | 0 | $0\frac{25}{36}$ |
| 8 | Cracas a Quilo | 0 | 0 | $5\frac{5}{9}$ |
| 20 | Soldi †a Lire | 0 | 0 | $8\frac{1}{3}$ |
| 6 | Lires a Piastre of Ex. | 0 | 4 | 2 |
| $7\frac{1}{2}$ | Lires a Ducat | 0 | 5 | $2\frac{1}{2}$ |
| 22 | Lires a Pistole | 0 | 15 | 6 |

## ROME.

### *Civita, Vecchia, Ancona, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| A | Quatrini | 0 | 0 | $0\frac{3}{20}$ |
| 5 | Quatrini = a Bayoc | 0 | 0 | $0\frac{3}{4}$ |
| 8 | Bayocs a Julio | 0 | 0 | 6 |
| 10 | Bayocs a Stamped Julio | 0 | 0 | $7\frac{1}{2}$ |
| 24 | Bayocs a Testoon | 0 | 1 | 6 |
| 10 | Julios a Crown current | 0 | 5 | 0 |
| 12 | Julios †a Crown stamped. | 0 | 6 | 0 |
| 18 | Julios a Chequin | 0 | 9 | 0 |
| 31 | Julios a Pistole | 0 | 15 | 6 |

## NAPLES.

### *Gaieta, Capua, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| A | Quatrini | 0 | 0 | $0\frac{2}{15}$ |
| 3 | Quatrini = a Grain | 0 | 0 | $0\frac{2}{5}$ |
| 10 | Grains a Carlin | 0 | 0 | 4 |
| 40 | Quatrini a Paulo | 0 | 0 | $5\frac{1}{3}$ |
| 20 | Grains a Tarin | 0 | 0 | 8 |
| 40 | Grains a Testoon | 0 | 1 | 4 |
| 100 | Grains a Ducat of Ex. | 0 | 3 | 4 |
| 23 | Tarins a Pistole | 0 | 15 | 4 |
| 25 | Tarins a Spanish Pistole. | 0 | 16 | 9 |

## SICILY AND MALTA.

### *Palermo, Messina, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| A | Pichila | 0 | 0 | $0\frac{1}{30}$ |
| 6 | Pichili = a Grain | 0 | 0 | $0\frac{2}{11}$ |
| 8 | Pichili a Ponti | 0 | 0 | $0\frac{8}{30}$ |
| 10 | Grains a Carlin | 0 | 0 | $1\frac{7}{10}$ |
| 20 | Grains a Tarin | 0 | 0 | $3\frac{1}{13}$ |
| 6 | Tarins †a Florin of Ex. | 0 | 1 | $6\frac{6}{13}$ |
| 13 | Tarins a Ducat of Ex. | 0 | 3 | 4 |
| 60 | Carlins †an Ounce | 0 | 7 | $8\frac{4}{13}$ |
| 2 | Ounces a Pistole | 0 | 15 | 4 |

### *Bologna, Ravenna, &c.*

| | | L. | s. | d. |
|---|---|---|---|---|
| A | Quatrini | 0 | 0 | $0\frac{1}{10}$ |
| 6 | Quatrini = a Bayoc | 0 | 0 | $0\frac{3}{5}$ |
| 10 | Bayocs a Julio | 0 | 0 | 6 |
| 20 | Bayocs a Lire | 0 | 1 | 0 |
| 3 | Julios a Testoon | 0 | 1 | 6 |
| 85 | Bayocs a Scudi of Ex. | 0 | 4 | 3 |
| 100 | Bayocs a Crown | 0 | 5 | 0 |
| 105 | Bayocs a Ducatoon | 0 | 5 | 3 |
| 31 | Julios a Pistole | 0 | 15 | 6 |

### VENICE.

*Bergama, &c.*

| | | | L. | s. | d. |
|---|---|---|---|---|---|
| | A Picoli | | 0 | 0 | $0\frac{7}{36}$ |
| 12 | Picoli | =a Soldi | 0 | 0 | $0\frac{1}{3}$ |
| $6\frac{1}{2}$ | Soldi | †a Gros | 0 | 0 | $2\frac{1}{6}$ |
| 18 | Soldi | a Jule | 0 | 0 | 6 |
| 20 | Soldi | †a Lire | 0 | 0 | $6\frac{2}{5}$ |
| 3 | Jules | a Testoon | 0 | 1 | 6 |
| 124 | Soldi | a Ducat current | 0 | 3 | $5\frac{1}{5}$ |
| 24 | Gros | a Ducat of Ex. | 0 | 4 | 4 |
| 17 | Lires | a Chequin | 0 | 9 | 2 |

### TURKEY.

*Morea, Candia, Cyprus, &c.*

| | | | | | |
|---|---|---|---|---|---|
| | A Mangar | | 0 | 0 | $0\frac{3}{20}$ |
| 4 | Mangars | =†an Asper | 0 | 0 | $0\frac{3}{5}$ |
| 3 | Aspers | a Parac | 0 | 0 | $1\frac{4}{5}$ |
| 5 | Aspers | a Bestic | 0 | 0 | 3 |
| 10 | Aspers | an Ostic | 0 | 0 | 6 |
| 20 | Aspers | a Soloto | 0 | 1 | 0 |
| 80 | Aspers | †a Piastre | 0 | 4 | 0 |
| 100 | Aspers | a Caragrouch | 0 | 5 | 0 |
| 10 | Solotas | a Xeriff | 0 | 10 | 0 |

### ASIA.

ARABIA. *Medina, Mecca, Mocha, &c.*

| | | | | | |
|---|---|---|---|---|---|
| | A Carret | | 0 | 0 | $0\frac{1}{3}$ |
| $5\frac{1}{4}$ | Carrets | =a Caveer | 0 | 0 | $0\frac{125}{200}$ |
| 7 | Carrets | †a Comashee | 0 | 0 | $0\frac{9}{10}$ |
| 80 | Carrets | a Larin | 0 | 0 | $10\frac{1}{8}$ |
| 18 | Comashees | an Abyss | 0 | 1 | $4\frac{1}{5}$ |
| 60 | Comashees | †a Piastre | 0 | 4 | 6 |
| 80 | Caveers | a Dollar | 0 | 4 | 6 |
| 100 | Comashees | a Sequin | 0 | 7 | 6 |
| 80 | Larins | †a Tomond | 3 | 7 | 6 |

### PERSIA.

*Ispahan, Ormus, Combroon, &c.*

| | | | | | |
|---|---|---|---|---|---|
| | A Coz | | 0 | 0 | $0\frac{3}{5}$ |
| 4 | Coz | =a Bisti | 0 | 0 | $1\frac{3}{5}$ |
| 10 | Coz | a Shahee | 0 | 0 | 4 |
| 20 | Coz | a Mamooda | 0 | 0 | 8 |
| 25 | Coz | a Larin | 0 | 0 | 10 |
| 4 | Shahees | an Abashee | 0 | 1 | 4 |
| 5 | Abashees | an Or | 0 | 6 | 8 |
| 12 | Abashees | a Bovello | 0 | 16 | 0 |
| 50 | Abashees | a Tomond | 3 | 6 | 8 |

### GUZURAT.

*Surat, Cambay, &c.*

| | | | | | |
|---|---|---|---|---|---|
| | A Pecka | | 0 | 0 | $0\frac{15}{64}$ |
| 2 | Peckas | =a Pice | 0 | 0 | $0\frac{15}{32}$ |
| 4 | Pices | a Fanam | 0 | 0 | $1\frac{7}{8}$ |
| 5 | Pices | a Viz | 0 | 0 | $2\frac{11}{32}$ |
| 16 | Pices | an Ana | 0 | 0 | $7\frac{1}{2}$ |
| 4 | Anas | a Rupee | 0 | 2 | 6 |
| 2 | Rupees | an English Crown | 0 | 5 | 0 |
| 14 | Anas | a Pagoda | 0 | 8 | 9 |
| 4 | Pagodas | a Gold Rupee | 1 | 15 | 0 |

### EAST INDIES.

*Bombay, Dabul, &c.*

| | | | L. | s. | d. |
|---|---|---|---|---|---|
| | † A Budgrook | | 0 | 0 | $0\frac{27}{800}$ |
| 2 | Budgrooks | =†a Rez | 0 | 0 | $0\frac{27}{400}$ |
| 5 | Rez | a Pice | 0 | 0 | $0\frac{27}{80}$ |
| 10 | Pices | a Laree | 0 | 0 | $5\frac{2}{5}$ |
| 20 | Pices | a Quarter | 0 | 0 | $6\frac{3}{4}$ |
| 240 | Rez | a Xeraphim | 0 | 1 | $4\frac{1}{5}$ |
| 4 | Quarters | a Rupee | 0 | 2 | 3 |
| 14 | Quarters | a Pagoda | 0 | 8 | 0 |
| 60 | Quarters | a Gold Rupee | 1 | 15 | 0 |

*Goa, Visapour, &c.*

| | | | | | |
|---|---|---|---|---|---|
| | †A Re | | 0 | 0 | $0\frac{27}{400}$ |
| 2 | Rez | =a Bazaraco | 0 | 0 | $0\frac{27}{200}$ |
| 2 | Bazaracos | a Pecka | 0 | 0 | $0\frac{27}{100}$ |
| 20 | Rez | a Vintin | 0 | 0 | $1\frac{7}{20}$ |
| 4 | Vintins | a Laree | 0 | 0 | $5\frac{2}{5}$ |
| 3 | Larees | a Xeraphim | 0 | 1 | $4\frac{1}{5}$ |
| 42 | Vintins | a Tangu | 0 | 4 | 6 |
| 4 | Tangus | a Paru | 0 | 18 | 0 |
| 8 | Tangus | a Gold Rupee | 1 | 15 | 0 |

### COROMANDEL.

*Madras, Pondicherry, &c.*

| | | | | | |
|---|---|---|---|---|---|
| | A Cash | | 0 | 0 | $0\frac{3}{80}$ |
| 5 | Cash | =a Viz | 0 | 0 | $0\frac{3}{16}$ |
| 2 | Viz | a Pice | 0 | 0 | $0\frac{3}{8}$ |
| 6 | Pices | a Pical | 0 | 0 | $2\frac{1}{4}$ |
| 8 | Pices | a Fanam | 0 | 0 | 3 |
| 10 | Fanams | a Rupee | 0 | 2 | 6 |
| 2 | Rupees | an English Crown | 0 | 5 | 0 |
| 36 | Fanams | a Pagoda | 0 | 8 | 9 |
| 5 | Pagodas | a Gold Rupee | 1 | 15 | 0 |

### BENGAL.

*Callicut, Calcutta, &c.*

| | | | | | |
|---|---|---|---|---|---|
| | A Pice | | 0 | 0 | $0\frac{5}{32}$ |
| 4 | Pices | =a Fanam | 0 | 0 | $0\frac{5}{8}$ |
| 6 | Pices | a Viz | 0 | 0 | $0\frac{15}{16}$ |
| 12 | Pices | an Ana | 0 | 0 | $1\frac{3}{4}$ |
| 10 | Anas | a Fiano | 0 | 1 | 6 |
| 16 | Anas | a Rupee | 0 | 2 | 6 |
| 2 | Rupees | a French Ecu | 0 | 5 | 0 |
| 2 | Rupees | an English Crown | 0 | 5 | 0 |
| 56 | Anas | a Pagoda | 0 | 8 | 9 |

### SIAM.

*Pegu, Malacca, Cambodia, Sumatra, Java, Borneo, &c.*

| | | | | | |
|---|---|---|---|---|---|
| | A Cori | | 0 | 0 | $0\frac{1}{400000}$ |
| 800 | Cori | =a Fettee | 0 | 0 | $0\frac{5}{36}$ |
| 125 | Fettees | a Sataleer | 0 | 0 | $7\frac{1}{2}$ |
| 250 | Fettees | a Sooco | 0 | 1 | 3 |
| 500 | Fettees | a Tical | 0 | 2 | 6 |
| 900 | Fettees | a Dollar | 0 | 4 | 6 |
| 2 | Ticals | a Rial | 0 | 5 | 0 |
| 4 | Soocos | an Ecu | 0 | 5 | 0 |
| 8 | Sataleers | a Crown | 0 | 5 | 0 |

### CHINA.

*Pekin, Canton, &c.*

| | | | L. | s. | d. |
|---|---|---|---|---|---|
| A | Caxa | | 0 | 0 | $0\frac{2}{25}$ |
| 10 | Caxa | = a Candereen | 0 | 0 | $0\frac{4}{5}$ |
| 10 | Candereens | a Mace | 0 | 0 | 8 |
| 35 | Candereens | a Rupee | 0 | 2 | 6 |
| 2 | Rupees | a Dollar | 0 | 4 | 6 |
| 70 | Candereens | a Rix-Dollar | 0 | 4 | $4\frac{1}{4}$ |
| 7 | Maces | an Ecu | 0 | 5 | 0 |
| 2 | Rupees | a Crown | 0 | 6 | 0 |
| 10 | Maces | † a Tale | 0 | 6 | 8 |

### JAPAN.

*Jeddo, Meaco, &c.*

| | | | L. | s. | d. |
|---|---|---|---|---|---|
| A | Piti | | 0 | 0 | $0\frac{2}{3}$ |
| 20 | Pitis | = a Mace | 0 | 0 | 4 |
| 15 | Maces | an Ounce Silver | 0 | 4 | $10\frac{1}{3}$ |
| 20 | Maces | a Tale | 0 | 6 | 8 |
| 30 | Maces | an Ingot | 0 | 9 | $8\frac{2}{3}$ |
| 13 | Ounces Silver | an Ounce Gold | 3 | 3 | 0 |
| 2 | Ounces Gold, | a Japanese | 6 | 6 | 0 |
| 2 | Japaneses | a Double | 12 | 12 | 0 |
| 21 | Ounces Gold | † a Cattee | 66 | 3 | 0 |

### AFRICA.

EGYPT. *Old and New Cairo, Alexandria, Sayde, &c.*

| | | | L. | s. | d. |
|---|---|---|---|---|---|
| An | Asper | | 0 | 0 | $0\frac{5}{9}$ |
| 3 | Aspers | = a Medin | 0 | 0 | $1\frac{2}{3}$ |
| 24 | Medins | an Italian Ducat | 0 | 3 | 4 |
| 80 | Aspers | † a Piastre | 0 | 4 | 0 |
| 30 | Medins | a Dollar | 0 | 4 | 6 |
| 96 | Aspers | an Ecu | 0 | 5 | 0 |
| 32 | Medins | a Crown | 0 | 5 | 0 |
| 200 | Aspers | a Sultanin | 0 | 10 | 0 |
| 70 | Medins | a Pargo Dollar | 0 | 10 | 6 |

### BARBARY.

*Algiers, Tunis, Tripoli, Una, &c.*

| | | | L. | s. | d. |
|---|---|---|---|---|---|
| An | Asper | | 0 | 0 | $0\frac{5}{9}$ |
| 3 | Aspers | = a Medin | 0 | 0 | $1\frac{2}{3}$ |
| 10 | Aspers | a Rial Old Plate | 0 | 0 | $6\frac{3}{4}$ |
| 2 | Rials | a Double | 0 | 1 | $1\frac{1}{2}$ |
| 4 | Doubles | a Dollar | 0 | 4 | 6 |
| 24 | Medins | a Silver Chequin | 0 | 3 | 4 |
| 30 | Medins | a Dollar | 0 | 4 | 6 |
| 180 | Aspers | a Zequin | 0 | 8 | 10 |
| 15 | Doubles | a Pistole | 0 | 16 | 9 |

### MOROCCO.

*Santa Crus, Mequinez, Fez, Tangiers, Sallee, &c.*

| | | | L. | s. | d. |
|---|---|---|---|---|---|
| A | Fluce | | 0 | 0 | $0\frac{1}{12}$ |
| 24 | Fluces | = a Blanquil | 0 | 0 | 2 |
| 4 | Blanquils | an Ounce | 0 | 0 | 8 |
| 7 | Blanquils | an Octavo | 0 | 1 | 2 |
| 14 | Blanquils | a Quarto | 0 | 2 | 4 |
| 2 | Quartos | a Medio | 0 | 4 | 8 |
| 28 | Blanquils | a Dollar | 0 | 4 | 6 |
| 54 | Blanquils | a Xequin | 0 | 9 | 0 |
| 100 | Blanquils | a Pistole | 0 | 16 | 9 |

### AMERICA.

ENGLISH. *Jamaica, Barbadoes, &c.*

| | | | L. | s. | d. |
|---|---|---|---|---|---|
| † | Halfpenny | | 0 | 0 | $0\frac{57}{160}$ |
| 2 | Halfpence | = † a Penny | 0 | 0 | $0\frac{57}{80}$ |
| $7\frac{1}{2}$ | Pence | a Bit | 0 | 0 | $5\frac{3}{8}$ |
| 12 | Pence | a Shilling | 0 | 0 | $8\frac{11}{20}$ |
| 75 | Pence | † a Dollar | 0 | 4 | 6 |
| 7 | Shillings | a Crown | 0 | 5 | 0 |
| 20 | Shillings | † a Pound | 0 | 14 | 3 |
| 24 | Shillings | a Pistole | 0 | 16 | 9 |
| 30 | Shillings | a Guinea | 1 | 1 | 0 |

FRENCH. *St Domingo, Martinico, &c.*

| | | | L. | s. | d. |
|---|---|---|---|---|---|
| † A | Half Sol | | 0 | 0 | $0\frac{117}{640}$ |
| 2 | Half Sols | = † a Sol | 0 | 0 | $0\frac{117}{320}$ |
| $7\frac{1}{2}$ | Sols | a Half Scalin | 0 | 0 | $2\frac{11}{16}$ |
| 15 | Sols | a Scalin | 0 | 0 | $5\frac{3}{8}$ |
| 20 | Sols | † a Livre | 0 | 0 | $7\frac{5}{16}$ |
| 7 | Livres | a Dollar | 0 | 4 | 6 |
| 8 | Livres | an Ecu | 0 | 4 | $10\frac{1}{2}$ |
| 26 | Livres | a Pistole | 0 | 16 | 9 |
| 32 | Livres | a Louis d'Or | 1 | 0 | 0 |

ENGLISH. *Nova Scotia, Virginia, New England, &c.*

| | | | L. | s. | d. |
|---|---|---|---|---|---|
| † A | Penny | | 0 | 0 | 1 |
| 12 | Pence | = † a Shilling | 0 | 1 | 0 |
| 20 | Shillings | † a Pound | 1 | 0 | 0 |
| 2 | Pounds | | | | |
| 3 | Pounds | | | | |
| 4 | Pounds | | | | |
| 5 | Pounds | | | | |
| 6 | Pounds | | | | |
| 7 | Pounds | | | | |
| 8 | Pounds | | | | |
| 9 | Pounds | | | | |
| 10 | Pounds | | | | |

The value of the currency alters according to the plenty or scarcity of gold and silver coins that are imported.

FRENCH. *Canada, Florida, Cayena, &c.*

| | | |
|---|---|---|
| † A | Denier | |
| 12 | Deniers | = † a Sol |
| 20 | Sols | † a Livre |
| 2 | Livres | |
| 3 | Livres | |
| 4 | Livres | |
| 5 | Livres | |
| 6 | Livres | |
| 7 | Livres | |
| 8 | Livres | |
| 9 | Livres | |
| 10 | Livres | |

The value of the currency alters according to the plenty or scarcity of gold and silver coins that are imported.

MONK, a term derived from the Greek, signifying *alone*, and anciently applied to such individuals as retired from the world to devote themselves wholly to religious exercises, abstinence, and solitude. Owing to the cruel persecutions to which the early Christians were subjected, not a few of them found it expedient to abandon the haunts of men, with the view of finding in desarts, and the most unfrequented places, that quiet and comfort which was absolutely denied them in society. In one of his letters, St Cyril, of Alexandria, censures some monks in Egypt, who, under pretence of applying themselves entirely to religion, lived in a most slothful and scandalous manner. This censure was no doubt well merited, and strikingly applicable to monks in general. The monks were in ancient times distinguished into Solitaries, Cœnobites and Sarabaites. Such as lived remote from all towns and alone were denominated Solitaries; those who lived in community with others in the same house and under the same superiors were called Cœnobites; and those who strolled about, having no fixed residence, were styled Sarabaites. The monks of modern times are Cœnobites, as they live together in a monastery, conform to a certain rule established by the founder, and adopt a particular habit characteristic of their order. Monks, properly so called, are endowed, or have a fixed revenue; such are the Bernardines, Benedictines, and others. The Capuchins and Franciscans are mendicants, and usually called religious, or friars.

MONK, George, was descended of an ancient and respectable family in Devon, and born in 1608. In early life he devoted himself to the military profession; and, in the expedition to the isle of Rhée, he was happy in obtaining a pair of colours. Some time afterwards he served in the Low Countries, where he acquired great repute on account of his eminent talents. Returning to his native country about the time of the breaking out of disturbances between Charles I. and his Scottish subjects, and being by the king elevated to the rank of major-general, he was soon after taken prisoner with his brigade by Sir Thomas Fairfax, and committed to the Tower until 1646, when he obtained his liberty by taking the covenant and agreeing to serve the Parliament. The forces in the north of Ireland were in consequence committed to his charge, and he actively exerted himself, until the disagreeable circumstance occurred of his being called to account for his treaty with the Irish rebels. Cromwell next sent him with a regiment to Scotland, where he signalized himself so remarkably, that he was actually entrusted as commander-in-chief, and appointed one of the commissioners for uniting Scotland with the Commonwealth. In conjunction with Admirals Blake and Dean, Lieutenant-general Monk was actively employed in the defeat of the Dutch in 1653. Being again ordered to Scotland in his former capacity, he continued there about five years, while, without incurring the least suspicion, he arranged matters in the best possible manner for the effectual restoration of the king. For his success in this great design he was amply rewarded, being afterwards created Duke of Albemarle, with a grant of L.7000 per annum, together with other emoluments. In 1664, when the Dutch war broke out, the duke had committed to him the care of the admiralty, together with the appointment of joint admiral of the fleet with Prince Rupert; and owing to the death of the Earl of Southampton in 1667, he was for the second time placed at the head of the treasury. He died at his estate of Newhall in the county of Essex in 1670, at the age of 62 years, and his remains were interred in the chapel of Henry VII. in Westminster Abbey. After his death was published, in folio, his *Observations on Military-Political Affairs*, written while under confinement in the Tower.

MONMOUTHSHIRE, a county of England, bounded on the north by Herefordshire, on the east by Gloucestershire, on the west by the counties of Brecknock and Glamorgan, and on the south-east by the mouth of the Severn, and extending upwards of 30 miles in length and 26 in breadth. It contains an area of 330,000 acres, is divided into six hundreds, and has 122 parishes. The river Usk divides this county into two unequal portions, the eastern and western; the latter of which is rather mountainous, while the eastern and larger portion presents a remarkably fertile surface, being well wooded and productive of corn and pasture. Monmouthshire is aptly styled the county of landscapes, as it abounds in delightful scenery, which is materially enlivened by the fine appearance of the rivers Wye, Usk, Mynnow and Rumney, together with the other streams that meander through the extensive valleys, and yield fertility to the soil.

The most remarkable mountains in this county are the Skyrryd, the Sugar Loaf, and the Blorenge. The highest elevation of the first of these, according to General Roy, is 1498 feet; the Sugar Loaf rises 1852 feet above the mouth of the Gavenny, and commands most extensive and interesting prospects; but the Blorenge is of very inferior elevation in comparison of the other two ridges, though it no less harmonizes with the vales in the formation of beautiful and picturesque scenery.

This county enjoys a mild and temperate climate, and the soil though various is generally very productive. A good deal of arable land is contained in the eastern division, while the western is chiefly devoted to the rearing of sheep. The native breed of cattle and horses is not of superior excellence; but the mules bred here and in Brecon are considered the best in the kingdom. The oxen are usually employed for the purposes of agriculture. The most considerable of the lakes of Monmouthshire is that from which the river Mynnow takes its origin. Stretching along the foot of the north-east extremity of Mynnyd Maen, it constitutes the reservoir of the county canal. The rivers are sufficiently supplied with fish, and the Wye and Usk in particular are famous for excellent salmon.

This county, especially its western division, is rich in iron, coal, lime, and other mineral treasures. Great activity and increase has been communicated to the coal-trade by means of the canal. Limestone abounds in the eastern division, where it is burnt on the spot for the general manure of the county. Many quarries of breccia for millstones, as well as of excellent stone for building, are wrought in different quarters. Most extensive iron-works have been carried on here since Queen Elizabeth's time; and these, together with the manufacture of japanned goods, occupy the industry of the inhabitants. The iron works established at Blenavon near the source of the Avon, are of such great extent as to employ more than 400 men. At Caerleon there are very extensive tin works, capable of making annually from 14,000 to 20,000 boxes of tin plates, each containing from 200 to 300 plates. Several manufactures, chiefly of metal, are carried on in different parts of the county, and a great deal of trade is effected at the towns of Usk and Chepstow. According to the returns to Parliament for the year 1815, respecting the poor-rates, the average number of persons relieved was 6½ in each 100, the average amount for the support of each of these L.6, 16s. 5½d., and the average rate levied on each individual 12s. 2¼d. In 1811, the population was 62,127. The county sends two members to Parliament.

MONMOUTH, the county town, is very agreeably situated at the junction of the rivers Wye and Mynnow, and consists of one principal street, leading from the bridge which crosses the Mynnow directly to the market-place. It is extensive and well built, and contains a spacious town-hall, a new jail after the plan of Mr Howard, and two ancient churches. Monmouth maintains a constant intercourse with the city of Bristol. The population in 1811 exceeded 3500.

MONNIER, Le Peter Charles, a respectable French astronomer, who was born at Paris in 1715. In his twentieth year he was admitted a member of the Royal academy; and he soon afterwards accompanied Maupertuis to Lapland for the purpose of measuring a degree of latitude. In 1748 he repaired to Scotland to take an advantageous observation of the annual eclipse of the sun, on which occasion he had the good fortune to effect a measurement of the diameter of the moon on the disk of the sun,—an attempt in which it is said none had succeeded before him.

He was much esteemed for his splendid talents by Louis XV., who himself felt a strong predilection for astronomy. This liberal patron of science commanded Le Monnier to draw up a meridian at the royal chateau of Bellevue in 1750, and in return for his labour rewarded him with the handsome present of 15,000 livres, which sum the magnanimous recipient applied to the purchase of new and improved instruments, with which he successfully conducted his most important observations. The monarch next bestowed upon him an excellent mansion to which he retired, and in which he pursued his astronomical studies till the breaking out of the revolution.

The celebrated Lalande was a pupil of Le Monnier, whom he held in merited respect, and whose invaluable papers he used his utmost endeavours to preserve from oblivion. It is a remarkable fact, that Le Monnier could not, by the most urgent entreaty, be persuaded to publish any of these papers, which though fraught with matter of essential value, he most unaccountably destined to destruction. This great astronomer died in consequence of a fit of appoplexy in 1799.

MONOCEROS, the unicorn, a new constellation, situated on the equinoctial, and containing, according to the Britannic catalogue, thirty-one stars, but according to Hevelius only nineteen.

MONOCHORD, a musical instrument of one string, as its name denotes, and anciently employed for ascertaining the proportion of sounds and intervals. The addition of another string to this instrument is an improvement, as thereby the harmony can be ascertained of two tempered notes in all the varieties of temperament. See Music.

MONODY, from the Greek, signifying *alone* and *I sing*, an ancient and plaintive kind of song, the purpose of which was to give vent to sorrow.

MONOGAMY, from the Greek, signifying *alone* and *marriage*, is a term opposed to polygamy, or having more wives than one. See Polygamy.

MONOGRAM, a cypher of letters, being a sort of abbreviation of a name used for seals, badges, arms, or the like.

MONOPOLY, the engrossing of commodities of any kind, with the view of private advantage by selling at a high price; or, in another sense, the term signifies a privilege granted by licence, and which gives to an individual or company the sole right of purchasing and disposing, making or using the article specified in the licence. Monopolies prevailed to such an extent in Queen Elizabeth's time, that they became intolerable about the commencement of the reign of James I.; and hence by 21 Jac. I. c. 3., they were, with the exception of certain patents not extending beyond 14 years, declared void, and contrary to law; and monopolists become subjected to heavy penalties. By statutes 2d and 3d Edward VI. c. 15. five victuallers or artificers combining to increase the price of commodities, or the rate of labour, are declared liable to a forfeiture of L.10, or twenty days imprisonment for the first offence; L.20, or the pillory, for the second; and, for the third, L.40, or else the pillory, loss of an ear, and perpetual infamy. See Monopolies, under Economy, Political.

MONRO, Alexander, M. D. the celebrated anatomist, was born in London in 1697, and being by his father designed for the medical profession, he received a liberal education at Edinburgh and London, and afterwards completed his studies at Paris and Leyden. Repairing to the Scottish metropolis in 1719, he became professor of anatomy to the Surgeon's company, and the regular public lectures he then delivered may be considered as the commencement of the far-famed medical school of Edinburgh. About two years afterwards he was employed in reading some chirurgical lectures, more particularly respecting wounds and tumours. It was at the suggestion of his father in 1720 that regular professorships of anatomy and medicine were instituted in the college of Edinburgh. The Doctor himself was appointed to the anatomical chair, and sometime afterwards Drs Sinclair, Rutherford, Innes, and Plummer were chosen professors of medicine. The establishment of an hospital now appeared an important desideratum, as thereby the students might enjoy the advantage of the practice of physic and surgery in addition to the ordinary lectures. A subscription for this laudable purpose was consequently set on foot by the Royal College of Physicians and Board of Surgeons, and a pamphlet respecting the great benefits that might result from the proposed humane

Monro.

institution. By this means a temporary hospital was soon prepared for there ception of patients, who were attended by physicians and surgeons of the highest eminence. But the subscription continuing to prosper, the foundation of the present Royal Infirmary was laid in 1738. In this excellent hospital many judicious suggestions respecting the plans and regulations were made by Dr Monro; and the hospital itself has since that time been so liberally endowed and extended as to be capable of accommodating 228 patients in separate beds. The most able physicians and surgeons attend these patients, and the students daily enjoy the incalculable benefit of witnessing their skilful and judicious treatment of almost every species of disease. In addition to the chirurgical lectures of Dr Monro on the more remarkable cases occurring in the hospital, an annual course of clinical lectures was, in 1748, begun by Dr Rutherford, the professor of the practice of physic.

As professor of anatomy, Dr Monro was, in 1725, received into the university, and his annual courses of lectures were unremittingly continued for the long period of 40 years. Subsequently to his resigning the business of the anatomical theatre to his son in 1759, he continued his clinical lectures at the Infirmary; and, after a long, useful, and active life, this ornament of society died in 1767, in the seventieth year of his age. His whole works, arranged, corrected, and illustrated with plates, together with a biographical sketch, was, in 1781, published in one vol. 4to, by his son and successor, Dr Alexander Monro.

MONRO, ALEXANDER, *Secundus,* M. D. son of the preceding, was born at Edinburgh in 1733, where he received a very liberal education under the auspices of his father, to whom he became assistant in his anatomical lectures in 1753. Having graduated two years afterwards, and likewise attained great eminence as a demonstrator and lecturer, he was, in the twenty-second year of his age, chosen professor of anatomy and surgery by the patrons of the university. With the view of perfecting his studies, Dr Monro now visited London, Paris, Leyden, and Berlin, at which latter place in particular he derived much benefit from the public and private instructions of Professor Meckel, who was then celebrated for superior talents, and attended by pupils from every quarter of the globe. Returning to his native city in 1758, he was received as a licentiate of the Royal college of Physicians, of which he became a fellow in the following year, and he then likewise succeeded his father as secretary to the Philosophical society. Such was the success of this excellent anatomist subsequently to the autumn of 1758, at which period he commenced his labours as colleague with his father, that he not only added very much to the celebrity of the medical school of Edinburgh, but at same time in effect promoted the good of the city and its inhabitants; for, averaging 350 students annually to have attended his lectures, the total number was 14,000, and the wealth thus introduced into Edinburgh has been moderately estimated at L.700,000. In 1762 a violent controversy was excited between Dr William Hunter of London and our professor, regarding their private claim to the discovery of the origin and use of the lymphatics. Dr Monro continued to execute the important duties connected with the anatomical chair without an assistant till the year 1800, when his son, the present professor, became his assistant. His surgical course was, however, delivered by himself till 1807; and, prior to 1809, he delivered the introductory lecture for the session. Dr Monro died at the advanced age of seventy-five, after having devoted above 60 years to the essential service of the human race.

Mons || Monster.

The lectures of Dr Monro are admitted to have been a most complete course of anatomy, physiology, pathology, and surgery; and, besides his eminence as a scholar and physician, this great professor was equally distinguished for his numerous virtues. As a husband, father, friend, and landlord, he was at once affectionate, tender, kind, and generous. In the pursuit of science and literature, Dr Monro was indefatigable: in anatomy and medicine, "his improvements were numerous and important;" and the Transactions of the Royal society were greatly enriched by his various contributions. See *An Account of the Life, Writings, and Character of the late Dr Alexander Monro, Secundus,* by Dr Duncan, senior.

MONS, the capital of Hainault, in the Netherlands, situated on the river Trouille, at the distance of 30 miles east from Brussels, is a spacious and commodious city, and contains, besides the great church, a town-house, an arsenal, and a castle. It carries on extensive manufactures of woollen stuffs and lace, has a great deal of trade, and is governed by a magistracy consisting of a chief, ten schevins, two pensioners, three greffiers, and others. The city is abundantly supplied with coal from the neighbourhood. Mons has been much subjected to the vicissitudes of war, and was last taken by the French under Pichegru in 1794.

MONSIEUR, a French term of civility, similar to Mr or Sir among the English. The plural is written Messieurs. In France the king's second son, or his brother, were formerly styled Monsieur, and the king himself was so addressed by his children.

MONSOON, or trade-wind, a periodical wind, which, in the southern and eastern oceans, continues in the same direction for one-half of the year, and blows in a contrary direction during the other half.

MONSTER, a birth or production of a living creature degenerating from the natural disposition of parts in the particular species. Objects of this description are of three kinds, being remarkable either for deficiency, redundancy, or deformity; and they have been sometimes denominated *lusus naturae,* as if they proceeded from nature in her sportive mood. It has been matter of controversy among the French academicians, whether monsters, properly so called, were formed such originally, or whether their deformed conformation may have been occasioned by some accidental change. The arguments on this curious question connected with minute accounts of such aberrations of nature, will be found in the *Memoirs de l'Acad. des Sciences* 1733-34, 1738-39. To account for the deviations from the ordinary course of nature exhibited in such extraordinary productions, different theories have been formed by different physiologists, but none of these have as yet been successful in throwing any great degree of light on the subject. It must be obvious, however, that these deviations can only be produced when nature is affected by such circumstances as are calculated to derange the primitive organization which belongs to the species. Physicians have in vain attempted to trace the causes of these productions, especially of those belonging to the human species, by supposing that deficient parts are destroyed by external pressure or violence, that superfluous parts are remains of another fœtus becoming adherent to a perfect one, and that compound fœtuses are formed of two grown together.

Monsters, in respect of structure, are of various kinds. Some have an excess of parts, as those with two heads and one body, two bodies and one head, or those with three arms or legs; but others, again, have a deficiency of particular parts, as the *acephalous*, which wants the head, or such as want the arms or legs. Other objects of this description are remarkable for deformed conformation, unnatural junction of particular parts or viscera, or derangement in one or more of their members. It is observed that monstrosities of nature are less frequent in the human species than in the brute and vegetable creation. It were an easy matter to enumerate many instances of the like in brutes, but the following may suffice: Cases have occurred of two calves being united only by the pelvis, and supported by four fore-legs and two hinder ones; of two of the same species united together in the body, with four legs in whole, and having each a distinct head and neck; of the head of a foal having one eye only, and that placed in the centre of the forehead, and of a lamb having four legs behind and two before. The aberrations in the vegetable kingdom are very curious. From the centre of the leaves of a rose a branch has been known to issue, furnished with leaves, and in length about two or three inches. In flowers of the ranunculus kind, it is not uncommon for a stalk to issue from the middle of one flower and produce another; and, indeed, leaves are frequently observed from the internal parts of which others originate. See *Memoirs de l'Acad. des Sciences* for 1707, 1724, and 1749.

Various instances are adduced by M. de Reville, M. de Maupertuis, and others, of the deformity of six fingers in the human species being continued in certain families for several generations; and M. Reaumur makes mention of a family at Malta having six fingers and as many toes. It may be questioned, however, if, in these cases, the supernumerary fingers were real ones.—*Journal de Physique*, 1774.

A description has been given by M. Geoffroy of a human monster born at Borrois in 1722. It consisted of two children without the inferior extremities, connected by a common navel, each of which was nursed separately, and the one sucked while the other slept. A similar production is mentioned by Buffon, which was born at Tzoni in Hungary in 1701, and exhibited in almost every country in Europe. These were united at the loins, and could see each other only by turning round their heads. In the upper half they appeared distinctly to be different persons. The one, Helen, was straight and tall, and the other, Judith, less, and rather crooked. They were attached to each other in their minds as well as in their bodies. The former was handsome, witty, and gay, but the latter was of a weak and slow understanding, owing, perhaps, to a palsy with which she was affected when only six years of age, and from the effects of which she never completely recovered. They were not uniformly subject to the same maladies, although both of them, at one time, had the small-pox and measles. At the age of twenty-one, Judith being seized with a fever fell into a lethargy and died; and just before she breathed her last, the unfortunate Helen likewise fell into an agony and expired. On dissection the viscera of each was found perfect.

In that unrivalled collection of anatomical preparations formed by the celebrated Dr William Hunter, now belonging to the university of Glasgow, there are upwards of sixty preparations of this sort, many of which are really wonderful. Among others, there is a child without the head and without arms, seemingly having no heart, lungs, diaphragm, or liver, with a skin somewhat resembling that of a pig, and covered with a very long down; also two children about the seventh month apparently growing together by the chest and abdomen.

MONTAGU, Lady MARY WORTLEY, eldest daughter of the Earl of Kingston, was born at Thornsley in Nottinghamshire in 1690. She, in early life, enjoyed the advantage of a liberal and accomplished education; and her literary talents, together with her distinguished rank and fascinating manners, have attached celebrity to her name. In her 22d year she married Edward Wortley Montagu; and her husband being, in 1716, appointed to succeed Sir Robert Sutton as ambassador at Constantinople, Lady Mary accompanied him on his arduous journey. In consequence of her travels at this period she was afterwards enabled to communicate to the public much interesting matter respecting the peculiar manners of the east, having had opportunities of information that no other travellers, whatever may have been their rank or quality, could ever obtain. To this intelligent and accomplished lady, the public is indebted for the introduction into England of inoculation for the small-pox, which she learned from observing the practice of the peasants of Belgrade. Lady Mary was very conspicuous among the great and gay at the court of George I., though her tranquillity was perhaps not a little ruffled by means of the aspersions thrown upon her character, as well as the inveterate enmity which subsisted between her and Mr Pope. In 1739 she was induced to remove to Italy for the recovery of her health; but, after an absence of twenty-two years from England, her constitution was found to be rapidly declining; and having returned home in 1761, she died in the following year. The letters of this remarkable lady are very justly appreciated. They were translated into French, and published at Rotterdam in 1764, and at Paris in 1783.

MONTAGUE, ELIZABETH, author of "An Essay on the Writings and Genius of Shakespeare," was the daughter of Matthew Robinson, Esq. of Yorkshire and of Horton in Kent, and was educated by the learned Dr Conyers Middleton. This lady was the founder of a literary society, which, from the circumstance of a gentleman connected with it wearing stockings of a blue colour, was styled the *Blue Stocking Club.* She was likewise remarkable for having honoured the London chimney-sweepers with a dinner on May-day of every year. Mrs Montague became a widow in early life, and she died in 1800.

MONTAIGNE, Michael de, an eminent French essayist, born at Perigord in 1533. His father designing him for the profession of the law, bestowed upon him a very liberal education. The Essays of Montaigne, first published in 1580, are well known, and treat of a variety of subjects. He died in 1592.

MONTAUBAN, a manufacturing town of the department of Lot in France, seated on the river Tarne, and formerly an episcopal see. It was wrested from the Huguenots in 1629, on which occasion the fortifications were destroyed.

MONTESQUIEU, Charles de Secondat, Baron, a distinguished French author, and the descendant of a noble family of Guienne, was born, in 1689, at the castle of La Brede near Bourdeaux, and educated with the greatest care. In 1714 his talents recommended him as a counsellor of the parliament of Bourdeaux ; and not long after he was chosen president à mortier. Subsequently to the year 1728, at which period he was admitted into the French Academy, he employed himself in literary pursuits, and spent a few years in a tour through Switzerland, Italy, Holland, and England. On his return to his native place he completed for the press the Causes of the Grandeur and Declension of the Romans, which was published in 1734. This was succeeded by his justly celebrated work on the Spirit of Laws, which appeared at Geneva, in two volumes 4to, in 1750 ; and the firm and dispassionate defence of it drawn up by himself, in opposition to the misconstructions of anonymous critics, is equally creditable to his wit and forbearance. Montesquieu died at Paris in 1755. His works, all of which have been translated into English, were published in 4to at Paris after his decease.

MONTE VIDEO, a city of the government of Buenos-Ayres, situated on the north side of the river Plata, is strongly fortified, and has a great trade in hides, tallow, and salt beef. The houses are of stone or brick, commonly one story high, and with flat roofs. It has a fine cathedral, a town-house, and a prison ; and the population is estimated at 20,000. This city was taken by the British in 1807, but afterwards evacuated. It was in possession of the Portuguese in 1817.

MONTFERRAT, a dutchy of Piedmont, having the Milanese on the east, and the territory of Genoa on the south, from which it is separated by the Appenines. The produce of corn, wine, oil, and silk, is very abundant. Casal is the capital.

MONTGATZ, an almost impregnable town of Lower Hungary, in the county of Pereczas, chiefly remarkable for having been ably defended by the wife of Count Tekeli, against a besieging army in 1688.

MONTGOMERYSHIRE, a county of Wales, is bounded on the north by Merionethshire and Derbyshire, on the east by Shropshire, on the south by Radnorshire, and on the west and south-west by Cardiganshire and part of Merionethshire, and extends about thirty-five miles in length, and thirty in breadth. It contains an area of 628,480 acres, is divided into six hundreds, with five market towns, and sends two members to Parliament. The aspect of this county is rather mountainous, but the south, south-east, and north-east parts, are tolerably cultivated, and the vales are very productive. Numerous flocks of sheep are reared on the elevated tracts, which, together with the different mineral products, constitute the chief source of the prosperity of Montgomeryshire. The Vyrnwy, Wye, Severn, and Tannat, are the principal rivers. Limestone is wrought in the neighbourhood of Llanymech and Porthwaun, and excellent slates are obtained from the hills about Llangynnog. Coal, lead, silver, and copper mines, have been occasionally wrought in different districts of this county, some of which have been productive of advantage to the owners, and carried on to a considerable extent. The principal trading towns are Newtown, Berhiew, Welsh-Pool, and Dolydran ; and flannel and coarse cloths are the chief manufactures. In the vicinity of Meifod have been discovered the remains of the Roman station, Mediolanum, besides which there are many other traces of antiquity.

*Montgomery*, the capital of the county, is a pleasant town, situated not far from the river Severn, and appears to have been anciently surrounded by a wall. The principal edifices are the church, built in form of a cross, and containing several monuments of the Herbert family, the guildhall standing near the site of the ancient castle, and a new jail. About two miles from the town, and on the road to Shrewsbury, stands Chirbury priory, an edifice founded for monks of the order of St. Benedict, in the reign of King John. The population of Montgomery, in 1811, was above 4600.

MONTH, that portion of time occupied by the moon in passing from a certain point to the same again, and called a periodical month; or the space of time between two conjunctions of the moon with the sun, denominated a synodical month. Likewise the time taken by the sun in passing one sign, or twelfth part of the zodiac, is, though incorrectly, styled a month. There are consequently two kinds of months, the lunar and the solar.—See *Chronology* under History.

MONTMORENCY, a town of France, in the department of Seine and Oise, and remarkable chiefly as the burial-place of the dukes of the same name. It stands seven miles north from Paris.

MONTPELLIER, the capital of the department of Herault in France. See Herault.

MONTREAL, an island in the river St Lawrence in North America, 28 miles in length and 9 in breadth, and so called from Mont Real, which rises to a great height in its centre. It is well cultivated, particularly on the south side, and is remarkably productive of vegetables and fruits. Montreal is about 60 miles distant from Quebec.

*Montreal*, the capital of the island of the same name in North America, and, as a city, next in rank to Quebec. It is regular and well built, and the public edifices are spacious and elegant. This place is remarkably adapted for trade, which is consequently carried on to a great extent. Furs, in particular, are shipped in large quantities for England. The supply of cattle, horses, hogs, and poultry, together with all sorts of fish, is abundant. The population is stated at 16,000. Montreal was surrendered to the British in 1760 by the French.

MONTROSE, a borough and sea-port town of Forfarshire in Scotland. See FORFARSHIRE.

MONTSERRAT, one of the Caribbean islands possessed by Great Britain, and so called from its resemblance to the mountain of the same name in Catalonia, is of an oval form, and about nine miles in length and six in breadth. It enjoys a salubrious climate, and, though mountainous, is productive of cotton, rum, and sugar, the valleys being very fertile. Montserrat was discovered by Columbus in 1493, but, though named by the Spaniards, it was planted by a colony from St Christophers about the year 1632. It lies 30 miles south-west from Antigua.

MONTUCLA, JOHN STEPHEN, a respectable French mathematician, born at Lyons in 1725, and educated in the Jesuits' college. In his sixteenth year, he commenced the study of law at Toulouse, and, after qualifying himself as an advocate, he removed to Paris, where he prepared his much celebrated work the History of the Mathematical Sciences. In 1755, he became a member of the Royal academy of Sciences at Berlin, and his History was published three years after. Being appointed secretary to Turgot in 1764, he accompanied him to Cayenne, for the purpose of establishing a settlement there. He was engaged in bringing out a new edition of his work when he died in 1799. Montucla was one of the original members of the National Institute, and was variously employed under the revolutionary government.

MONUMENT, in architecture, a structure erected in commemoration of any extraordinary person or occurrence. The ancients erected monuments of stone in honour of the deceased, and engraved on them the names and actions of the individuals; and in course of time these sepulchral edifices were so improved upon that they became the lasting admiration of mankind.

*The Monument*, emphatically so called, is an elegant pillar, erected by order of Parliament, in memory of the fire of London in 1666. This building, designed by Sir Christopher Wren, and completed between the years 1671 and 1677, is of the Doric order, fluted, 15 feet in diameter, and 202 feet in height, and is constructed of Portland stone, with a black marble staircase of 345 steps. The pedestal is 21 feet square, and 40 feet high, and is ornamented in front with rich and curious emblems in *basso relievo.*

MOODIE, WILLIAM, D. D. professor of Oriental languages in the university of Edinburgh, and one of the clergymen of that city, was a native of the county of Aberdeen, and eldest son of the first minister of the parish of Gartly, where he was born in 1759. Discovering in early life a predilection for the church, he commenced his academical studies at the university of St Andrews, from which he afterwards proceeded to Edinburgh, where, having attended a course of theological lectures, he became a preacher of the gospel in 1781. About three years after this period, he was presented to the church of Kirkcaldy in Fife, where, owing to the divided state of that parish, originating from some imputed misconduct of the patron, he experienced the most formidable opposition, which, however, was soon converted into sincere esteem and attachment, by the mild and conciliatory conduct of Dr Moodie. In 1787, he was fortunate in being appointed to St. Andrew's church in the city of Edinburgh, a situation more congenial to his inclination, and more suited to his eminent talents. The duties of this important charge he continued to perform with great fidelity, without the aid of a colleague, till the year 1801, and during that period he even found leisure to cultivate various branches of literature. The peculiar qualifications of Dr Moodie, pointed him out as a fit person for the professorship of Hebrew in the university of Edinburgh, which became vacant in 1793, and to which he accordingly succeeded. With the utmost assiduity he laboured in this department; and by his happy talent of communicating, with clearness and facility, a knowledge of the Hebrew tongue, he inspired his pupils with an ardour for studies hitherto in a great measure neglected, but which had begun to revive under the auspices of his immediate predecessor, the Rev. Dr (now Principal) Baird. Possessing an intimate acquaintance with other oriental languages besides the Hebrew, he, for several years, taught the Persian with considerable success to young gentlemen preparing for India. In 1799, he had the honour of being appointed to preside in our highest court of ecclesiastical judicature. This distinguished scholar possessed but an infirm constitution. He was, through life, subject to severe stomachic complaints, which his unremitting application to study rendered more and more acute; and the violent and irresistible attacks of these disorders at length put a period to his existence in 1812.

As a preacher of the gospel, and a professor of Oriental philology, Dr Moodie was greatly esteemed. In his discourses from the pulpit he "displayed an extent of information, a soundness of judgment, a delicacy of sentiment, and an elegance of taste, which, accompanied with a delivery peculiarly tender and impressive, arrested the attention, and interested the feelings of all whom he addressed." In ecclesiastical politics he was remarkable for moderation, and his anxiety was wholly directed towards the interests of religion, and the national church. A volume of his sermons has been published since his death.

MOON, one of the secondary planets, revolving about the earth as its primary from west to east.—See ASTRONOMY.

MOOR, Sir JONAS, a learned English mathematician, born at Whitby in Lancashire in 1620. His talents soon recommended him to Charles I. by whom he was employed as tutor to his second son

James; and subsequently to the Restoration, Charles II. conferred upon him the order of knighthood, and the appointment of Surveyor-general of the Ordnance. The influence which Sir Jonas now enjoyed at court, was laudably directed to the promotion of learning and the general good. His principal work, A General System of Mathematics, was published after his death, in 2 vols. 4to, in 1681.

MOORE, John, M. D. a native of Stirlingshire in Scotland, was born in 1730, and died at Richmond, 1803. He was educated for the medical profession, —attended first the medical classes at the university of Glasgow, and afterwards the lectures of his celebrated countryman, Dr Hunter, at London; and having been engaged for some time as assistant-surgeon in the Coldstream Guards, he next accompanied the Earl of Albemarle, the British ambassador, to Paris, and not long after the son of the Duchess of Hamilton and Argyle on his travels through different kingdoms of Europe. His moral character and his talents rank high, and he is chiefly celebrated as an author and tourist. His works are, Medical Sketches,—a View of Society and Manners in France, Switzerland, and Germany,—a Journal during his residence in France in 1792,—and the novels, Zeluco, Edward, and Mordaunt.

MOORE, Sir John, son of the former, a distinguished British general, was born at Glasgow in 1761, and, under the auspices of the Duke of Hamilton, he in his 15th year entered into the 51st regiment, at that time stationed at Minorca. Having gradually risen to the rank of a lieutenant-colonel, his meritorious conduct at the siege of Calvi, where he received his first wound in 1794, greatly prepossessed General Charles Stewart in his favour. Soon after that period, he repaired to England, and having been promoted to the rank of a brigadier-general in the West Indies, he immediately joined Sir Ralph Abercromby at Barbadoes, who assigned to him a most important department in the hazardous expedition of the British against St Lucie; in which service he acquitted himself so much to the satisfaction of that celebrated general, that the government of the island was conferred upon him by Sir Ralph immediately after its capitulation. The nature of the climate, and the state of his health, rendering it necessary for him to quit that situation, he next proceeded with Sir Ralph, first to Ireland, during the rebellion, and soon after, in the capacity of major-general, to Holland, with the expedition in 1799; from which he proceeded to Egypt, where he soon after had an opportunity of signalizing himself at the capture of Alexandria. On his return to England at the peace, he was raised to the rank of knighthood, and honoured with the order of the Bath. Soon after the commencement of the war in Spain, Sir John was called upon, in 1808, to take the command of a body of troops which the British government had destined to aid the Spanish patriots against the usurpation of Buonaparte; and in the following year, having been promoted to the chief command of the British troops in the Peninsula, he unfortunately fell at the battle of Corunna. Comforted with the idea of victory, and the consideration that his country would be satisfied that he had done his duty, he died like a truly magnanimous soldier, and his remains were interred in a bastion in the garrison of Corunna. He was characterised by Lord Castlereagh, in the House of Commons, after his death, "as possessing, in an eminent degree every valuable quality that can dignify the man and enhance the superiority of the soldier." With a highly cultivated mind, with a countenance full of vivacity and intelligence, and a figure uncommonly handsome, he was active, and capable of bearing great fatigue; but towards the close of his brilliant career he had begun to stoop, and was much broken down, both by the wounds he had received, and the severity of the service he had undergone in various climates. His grateful countrymen, in token of the high esteem which they entertained for him, have erected a splendid statue to his memory in his native city.

MOORING denotes the proper fastening of a ship, by means of cables or chains attached to anchors at the bottom or fastened to the shore. This may be effected either by the head, or by the head and stern of the vessel. To moor by the head, the anchors must be disposed according to the particular situation, and other circumstances. Where the tide ebbs and flows, and there is little convenience for veering about, it is proper to direct one anchor to the ebb and another to the flood; and to lay the anchors in the same way if the ship be moored by head and stern. In a road, or bay, the anchors are generally opposed to the wind. Riding in a bay or road with a northerly wind and heavy sea from the same direction, the anchors passing from the opposite bows should lie east and west from each other, so that both cables may secure the vessel against wind and sea.

MOORINGS are generally a collection of anchors, chains, and bridles, disposed across the bottom of a haven, or river, to enable the shipping to ride safely therein. These are generally fixed in the harbours contiguous to his Majesty's dock-yards at Plymouth, Chatham, Portsmouth, Deptford, and other places.

MOORS, Mauri, a race of men formed into various opposing tribes, and inhabiting Africa and Arabia, but of the origin of whom little is correctly known.—See Man, and also Morocco.

MOOSE, or Elk.—See Mammalia.

# MORAL PHILOSOPHY.

Definition.

Moral Philosophy is that science which unfolds to man the knowledge of his duty, by directing his attention to the study of his nature, the relations of his condition, and the motives of his actions.

To man, the diversity of whose duties is only limited by that varied and indefinite succession of circumstances to which the events of life give rise, a knowledge of the principles of his nature, and of that moral relation towards God and man which he sustains in every stage of his progress, is of the utmost importance, since the happiness of this life, as well as that of an endless existence, depends upon the due regulation of his conduct and affections. The knowledge of his duty is, no doubt, one thing, and the practice of it another; but he must necessarily be well acquainted with his duty before he can practise it consistently. Experience teaches us that we ought not to be guided by the general conduct of mankind, who, in their pursuits, too frequently confound the ideas of right and wrong. Comparatively few possess those advantages which enable men of cultivated minds distinctly to perceive the proper line of duty. With amazing ardour and perseverance the bulk of mankind exert themselves in the pursuit of objects which owe the estimation in which they are held to the erroneous judgment formed of their value. When individuals occupy their minds with false notions of honour, pleasure, and interest, and become confirmed in bad habits, their consciences are but rarely consulted, and they think not so much of what is right as of what will not expose them to punishment. Pleasure or happiness is invariably pursued by all; yet not a little diversity of opinion prevails respecting the objects which are most worthy of regard and best calculated to produce the greatest good of which human nature is susceptible. It is, however, the province of Moral Philosophy to impress man with a due sense of the dignity of his moral and intellectual nature, and to inculcate the practice of all those virtues which accord with the high destination for which heaven has ordained him. Appealing to nature or fact, moral philosophy depends on observation, and builds its reasonings upon the fullest induction of particulars of which the subject will admit. It inquires how man is constituted, from what principles and dispositions his actions flow, and what duties he is by his nature destined to fulfil.

In the early ages of the world, the precepts of morality were not digested into any systematic form, but were conveyed in short isolated sentences or general maxims. They were put in the form of proverbs and wise sayings, fables, and allegories, to arrest the attention and imprint the rules of human conduct on the heart, and were thus taught by the father to the son, and conveyed from one generation to another. Of this kind are the Proverbs of Solomon, the Words of Agur, the Golden Verses of Pythagoras, and the Fables of Æsop. To please the ear and assist the memory, these maxims were sometimes delivered in verse.

Instinct.

There have been numerous inquiries concerning the principles of morals, and writers have differed from one another respecting the nature and foundation of virtue, according as they took a different view of the subject, and according to the particular notions they formed of good and evil.

In treating of the principles of moral science, we are naturally led to consider the powers of the mind, which have been divided into those of the understanding and of the will. By the former we ascertain facts, perceive what is true from what is false, and distinguish good from evil; and by the latter we form decisions respecting them, and regulate our conduct by choosing what is virtuous and shunning what is vicious. The powers of the will only are concerned with morals, although those of the understanding are of essential use in directing the will.

There are certain principles in the human mind which instigate the will to act or determine; and by philosophers these are called active powers. Human actions originate from these, and our moral worth depends on the use we make of them. Some of these active powers are in common to us with the brutes; but others are of a more exalted nature, and are influenced by motives which are not even bounded by our earthly hopes. Of these active powers we shall here treat in the following order: Instinct, Habit, Appetites, Desires, Affections, Passions, Disposition, Reason, and Conscience.

*Instinct.*—In treating of the active powers, instinct seems first to merit our attention. Instinct is a blind impulse to action, without knowing the cause, or having any end in view. It operates independently of reason, and has been given to inferior animals instead of reason and understanding. Creatures inferior to man perform certain acts, and accomplish works which, to all appearance, would require no small effort of reason and ingenuity. "The conies," says Solomon, "are but a feeble folk, yet make they their houses in the rocks. The locusts have no king, yet go they forth all of them by bands." The bee forms its cells with the greatest mathematical exactness, and birds of every species build their nests, and hatch and feed their young, through a natural impulse. The actions of a child cannot proceed from either reason or experience, but the babe sucks as well at the first as if it had learned. Besides the instincts peculiar to childhood, there are others which continue through the whole of life, such as the bringing down of the eye-lids at short intervals, and of turning the eyes in every necessary direction to make vision more correct and distinct. The Author of our being has not left the power of these actions to reason, but to instinct, as a more infallible guide. In like manner, every class of animals is wisely provided with a variety of instincts peculiar to itself, and which direct them in almost every action.

Habit.

Appetites.

By these they are guided not only to the food most agreeable to their taste, and most suitable for their nourishment, but are also directed in the form and construction of the habitations peculiar to their species. This infallibility of instinct, so remarkable in the lower animals, has been bountifully bestowed upon them for their comfort and preservation; and nature having rendered them almost incapable of any ulterior improvement, their operations are marked at the very first with all the perfection to which they are ever destined to arrive. It is true, indeed, that their operations may perhaps occasionally be improved by instruction; but in regard to animals in a domestic state, such a change is not so much to be attributed to the animal itself as to the individual by whom it is trained.

Instinct regulates the conduct of man only so far as regards the vital functions; if it were otherwise, he could not be considered a moral agent. To constitute him a moral agent, he must be influenced by the choice of good and evil; he must have the liberty of determining between right and wrong, and of weighing the motives which are to influence him in the struggle between duty and inclination. Were man led to obedience by instinct alone, there could be no merit in the performance of his duty, since it is only when he conquers an evil propensity by wisdom and virtue that he can be gratified with the victory over temptation. The lower animals are not only directed by instinct to the proper objects of their gratification, but also to the proper measure of it. Mankind are placed in a different situation, being under constant temptation to excessive indulgence; and no sooner do they yield to these than they entail upon themselves and others disgrace and misery. To the evils arising from this source mankind are nevertheless indebted for the opportunity of calling forth the exercise of the noblest virtues; and it is from this state of misery and moral evil that we may learn, that man is destined not so much for the sensual indulgence of this present state as for the happiness of a life to come. Treating of the difference of instinct in man and the inferior animals, Mr Stewart makes the following remarks: "In what does the difference consist? Do their faculties differ in degree only, or is there an essential difference in their natures? The followers of Des Cartes adopt the latter opinion, and regard the brutes as mere machines. Their successors have gone into the opposite extreme, and have attempted to trace the superiority of man to some peculiarities in his organization or external condition. In opposition to these doctrines of modern materialists, many circumstances prove that our intellectual and moral nature distinguishes us from every other inhabitant of this world. Perhaps this is the only instance in which the regular gradation throughout the universe entirely fails."

*Habit*, which is usually defined the result of repeated acts, agrees with instinct in so far as our actions are performed without attending to them; but differs in this, that it is not natural but acquired. Thus, in the art of writing, the learner must first attend to the particular shape of every letter, but, after long practice, he acquires a facility or habit of forming his letters in a peculiar way, without the trouble of reflecting on their form. In every branch of art a peculiar mechanical habit is acquired. Long apprenticeships are necessary for particular trades, and great advantages arise from limiting the attention of the workmen to a few operations, that they may acquire the habit of performing these with skill and accuracy. Every habit of this kind must be so perfect that the operator shall be able to perform the work with the greatest facility and exactness; and it is owing to this that the manufactures of one country excel those of another in point of taste or perfection. To this peculiarity in our constitution of doing almost whatever we attempt with greater accuracy and perfection on every succeeding trial, we may trace the progress of art, and that elegance, both in works of mechanism and of genius, which is conspicuous in civilized society. To habit we may also trace that wonderful proficiency which has often been attained in those arts which human power or dexterity seemed inadequate to reach. The surprizing feats of the juggler are performed by the aid of habit; and the still more astonishing and more dignified power of extemporaneous eloquence is, at least in a great measure, derived from the same source. Thus, perseverance in the frequent repetition of the same acts will surmount the greatest difficulties, and habit render that practicable, and even pleasant, which in its nature appears formidable and repugnant. Habits acquired by a liberal education are of great advantage, and are calculated in a high degree to facilitate mental improvement. A beginner will find more difficulty in comprehending some of the propositions in the first book of Euclid than one accustomed to mathematics will experience in the most abstract speculations of the higher geometry. A person who has attained any particular art will find less difficulty in acquiring a second than he did in the attainment of the first, if the same powers are called into exercise in both.

Although frequent practice does not in all cases constitute habit, yet the term may be applied to such practices as are out of the common course, when they become permanent in their effects; or it may be applied to natural practices, when these lead to frequent and excessive indulgence. Some special circumstance, or the advice or example of some friend whom we esteem, induces us scrupulously to perform a particular duty, which we are led to consider of preferable importance to every other, and the practice at length becomes confirmed. On the other hand, the contagion of evil example, or excessive indulgence in any particular practice, by long continuance acquires such strength that no effort can change it; and hence habit has been called a second nature. Of how much value, then, is a proper system of moral education for the attainment of proper habits. When we consider how easily habits are formed, and with how much difficulty they are relinquished, it becomes a matter of the greatest importance that the impressions made on the mind at an early period of life should be of a character favourable to virtue.

*Appetites.*—Our appetites may be referred exclusively to the body, the feelings which they excite prompting to those exertions by which the human

Appetites.

frame is preserved and sustained, and ceasing as soon as the end is accomplished which they were intended to effect. Of the three appetites, hunger, thirst, and sexual enjoyment, the last, though the least necessary for the preservation of the individual, is the strongest. The two first are more immediately selfish, or rather individual appetites. All of them are common to man with the inferior animals, and not only originate in the body but are essentially necessary in the economy of nature. Besides natural appetites, there are others created or acquired, which are often equally strong. Men frequently become addicted to practices and indulgences which, though at first repulsive, and even disgusting, are ultimately attended with pleasure, and, when discontinued, excite a feeling of uneasiness, which character, comfort, and health are on many occasions sacrificed to remove. Those who have been accustomed to the use of opium, or of intoxicating liquors, are seldom ever known to relinquish it. In addition to these natural and acquired appetites, some philosophers think that the disposition we feel alternately to action and to rest are appetites also, although under a different form.

Some authors have divided appetites into rational and sensitive. When our inclination is proportioned to the real value of the object, and is directed by reason, it is denominated rational appetite; but when a blind propensity directs us to the attainment of any object, it is called sensitive appetite. Dr Reid limits the word appetite to that class of desires which are accompanied with an uneasy sensation, and which are strong or weak in proportion to the desire of their proper objects, which are not constant, but being sated for a time by gratification, return after certain periods; and of such appetites, hunger and thirst are examples.

The effects of *hunger* upon man and the lower animals are materially different. Whilst the latter are left to gather their food from the natural productions of the earth, the former is induced to cultivate the soil, and to enquire into the qualities and properties of his food; whence he acquires a great variety of general knowledge, not only respecting the nature of the produce, but also the qualities of the soil. From the conviction that he has a natural right to the land or the fruits which he cultivates for his subsistence arises the distinction of property, which could never have been known had the appetite of hunger not prompted him to the pursuits of agriculture. Almost all the duties of social life depend on this important distinction; and man is consequently led, by his very appetites, to improve his intellectual nature, and to cultivate all the tender feelings of sympathy and benevolence.

The appetite of *thirst* likewise produces some remarkable effects on the feelings and the moral conduct of man. To gratify this appetite with some more agreeable beverage than that of water, he is naturally led to new discoveries, by which his active powers are exercised. A great variety of liquors have been extracted from herbs and flowers, and room has been thus afforded for the exercise of industry and ingenuity on the one hand, while, on the other, a field is opened for the exercise of the moral faculties. These liquors, by the intoxicating qualities which they possess, excite and lead men to vicious practices, of which reason and conscience disapprove; but from the evils connected with intemperance we are warned to guard against excess, and to exercise self-denial and moderation, which are alike conducive to present comfort and future prosperity.

Desires.

From the *sexual appetite* originates another class of active principles, productive of many great and important results. While, in the lower animals, this appetite is gross, in man it stimulates to love, which, in a virtuous mind, is ever accompanied with the most delightful and tender associations. Being altogether different from the attachment which takes place among the inferior animals, the passion of love is founded on esteem, and leads the sexes to that paramount and lasting bond of union which, by marriage, becomes indissoluble during life. In consequence of this bond of connection, an almost endless variety of feelings, hopes, and endearing associations arise between husband and wife, parents and children, relations and friends, all of which powerfully excite man, not only to promote the welfare and happiness of his family, but that of the society with which he may be more immediately connected, and of all mankind.

*Desires.*—The difference between appetites and desires, seems to be simply this, that the ultimate end of the one is physical, and of the other moral. They are referred by Dr Reid to the three following heads,—the desire of knowledge,—of esteem,—and of power; and to these Mr Stewart has added two more,—the desire of society,—and the desire of superiority, or the principle of emulation. These desires originating in the mind, are of a nature infinitely more dignified than instinct and appetites which man has in common with the inferior animals, and are calculated, in the highest degree, to promote his intellectual improvement.

*The desire of knowledge* may be regarded in youth as an instinctive principle. A child is curious to be informed about little trifling affairs, and seems anxious to acquire information concerning the objects around him; but so soon as he is capable of perceiving the great utility of knowledge, this may be considered as a rational desire. Every reflecting individual must have perceived a principle in his mind by which he is led to ascertain the properties of those objects with which he is surrounded,—to investigate their mutual relations, and the effect they produce on his internal senses. To this principle, when vigorously acted upon, may be traced the difference which exists between savage and civilized man. The savage, no doubt, in some degree feels its force, but obeys its impulse no further than is absolutely necessary for his preservation, and consequently remains in that state of rude nature beyond which it is impossible to pass without intellectual exertion and improvement. Civilized man, on the other hand, derives the noblest gratification of which his nature is capable from those exertions to which he is prompted by the desire of knowledge. No effort is spared to remove those obstructions which oppose his progress in intellectual improvement; and the pleasure he feels from the attainment of his object is only enhanced by the recollection of the difficulties which his ardour and perseverance have enabled him to surmount. The desire of knowledge becomes more ardent as the progress of society advances in improvement; but although a certain degree of it be requisite in every stage, yet the desire of knowledge, for its own sake, is felt to operate upon the mind only when it has arrived at a high degree of improvement.

The gratification of the external senses gives rise to an almost infinite variety of desires. The ear is delighted with the pleasures of music, of eloquence, and of poetry; the eye is pleased with the beauties of colour, of painting, and of other imitative arts; and the taste, touch, and smell, have each their peculiar gratifications,—all calculated to stimulate to the acquisition of knowledge, although mankind pursue them chiefly for the purpose of gratifying their own inclinations. But all these desires, originating with the senses, are not necessarily connected with our moral feelings, or in any degree allied to virtue. Our belief in the existence of the Deity, of the perfections of his works, and of his government, and of our being accountable to him as the Governor of the world, originates, not in the senses, nor in the appetites and desires of our natures, but in our intellectual faculties, by the use and exercise of which we are compelled to admit the existence of God and his moral government, the reality of which has been more perfectly discovered to us by divine revelation. It is in the word of God that we must learn our obligations to obey his will, and the duties of our moral nature, and that we are accountable to him, and must imitate his goodness and his purity if we ever expect to become the objects of his regard. From this source all our moral principles are derived, and from this it is that human laws derive all their sanction and all their power.

The *desire of esteem*, which may be regarded as a modification of self-love, seems instinctive, and is observed to operate in early life powerfully and universally, before higher principles attain any sway. It would be difficult to conceive that an individual, uncontaminated by vice, could be unmoved by expressions of scorn, ridicule, and contempt; or receive, without complacency, the approval of those whose approbation and sympathy he was desirous to obtain, or whose virtues he had been accustomed to revere. Even in children we perceive this principle distinctly developed; and to its operation their petty contests may, in general, be traced. The importance of this principle to society is obvious. In proportion to the strength of the desire, it urges us to follow that line of conduct which is most likely to secure the object that excites it; and although perhaps this be really a selfish feeling, yet the tendency in relation to society is more beneficial than it is to ourselves. It counteracts many of the evil propensities of our nature, and shews the wisdom of that beneficent Being who formed the human mind, and implanted principles by which we are irresistibly led to promote, in some degree, the interests of our fellow men. It urges us, as it were by a kind of necessity, to that course of action which the operation of liberal principles would, on all occasions, induce us to follow.

The *desire of power*, or the principle of ambition, next merits attention. When we consider man as a rational being, and engaged in the pursuit of objects which occupy the attention of others endowed with the same faculties, it is obvious that a desire to possess the means by which his end may be attained must form one of the principles of his nature. This is what philosophers term the desire of power, and in proportion to the degree of strength in which it exists, our exertions will be marked with weakness or energy. Its operation is twofold, and it leads us at one period of life to exult in the possession of physical power, and at another in the vigour of intellect. In youth, our exertions, when voluntary, are physical; towards the decline of life, if the power of exertion remain, they are generally intellectual. Wealth, honour, and applause, may be considered as modifications of the principle of ambition, and they appear at first sight to increase our enjoyments, and to gratify the desire of power, by giving us an ascendency over others. When acquired, however, they not unfrequently enslave us, and place us in the condition of those over whom we hoped they would enable us to display our superiority. It is much to be regretted that mankind should so little regard the means by which those objects are obtained which their ambition leads them to pursue. While urged along by the desire of power, we rarely reflect that the same desire is common to the species. Our attempts, in consequence, to obtain the objects we have in view, are too frequently inconsistent with the welfare of society, and thus give rise to many of those inconveniences which pervade the political condition of mankind, and introduce the alternate ills of tyranny and despotism. In this case, the desire of power is termed ambition, and degenerates into a passion which no human consideration can tame, and which no moral force can modify or resist. Into this principle, in the opinion of Cicero, the love of tranquillity and retirement is resolved; and the love of liberty, says Mr Stewart, proceeds in part from the same source. The idea of power, continues this distinguished writer, is also, in some degree, the foundation of the pleasure of virtue: We love to be at liberty to follow our own inclinations, without being subjected to the control of a superior; but this alone is not sufficient to our happiness. When we are led, by vicious habits, or by the force of passion, to do what reason disapproves, we are sensible of a mortifying subjection to the inferior principles of our nature, and feel our own littleness and weakness. The sense of freedom and independence, elevation of mind, and the pride of virtue, are the natural sentiments of the man who is conscious of being able at all times to calm the tumults of passion, and to obey the cool suggestions of duty and honour.

Whether the *desire of society* be an instinctive principle, whether men at first associated together for mutual protection, or whether this association necessarily arises from the peculiar circumstances of their condition, has long been disputed. If this be not an original principle in man, like that which operates in gregarious animals, it cannot be denied, at least, that it is a very strong one, and that the pleasure arising from social intercourse must be extremely powerful. In the nature of man, there is certainly nothing anti-social, nor is he induced to associate with his species merely for mutual protection against powerful enemies. The pleasure arising from social intercourse, as derived from experience, it may be maintained, would alone be a sufficient inducement to lead men to seek the society of their species, since those individuals who have devoted their lives to solitude are comparatively few; and even among such as have secluded themselves from the blessings of social life, the greater part have been led to do so from feelings of remorse or disappointment. It would seem, therefore, from the gratification and pleasure which the great bulk of mankind experience in the company and society of one another, that there does exist a principle from which this feeling of pleasure originates. If it be denied that there is a social propensity in man, how are we to account for those affections and dispositions of mind by which he is so admirably fitted for the society of his species? So powerful, indeed, is the influence of the desire of society, that man generally prefers even a state of disquietude to a life of solitary repose. To the vicious themselves, society is delightful; and amid all the turmoils to which mankind are exposed, there are, perhaps, few who would not prefer the intercourse even of persons whom they despise to a life of solitude and seclusion.

This social propensity in man is no doubt to be traced to the constitution of his nature, and the conjugal, parental, and social ties, which necessarily arise out of his circumstances and situation. The mutual relations which men bear to each other tend to consolidate society: they connect men together in the strongest bonds; and as population increases, the principle of association gradually extends its influence from parents to children, from children to tribes, and from tribes to kingdoms. Indeed, every people and every nation may trace their political ties, and their mutual bonds of union, to those endearing relations which result from family connections, and which have been matured and strengthened by the laws and the wisdom of ages. Is it not, then, reasonable to conclude, that the origin of the social system is neither accidental nor occasioned by a feeling of the helpless condition of man, but that divine wisdom has given him such a nature, and placed him in such a condition, as induces him to seek the society and fellowship of his species by numberless and endearing ties and associations? On this principle, all civil and political regulations depend; and when, in the midst of extended communities and complicated interests, these relationships are in a great measure forgotten, they are further strengthened by civil and religious sanctions and obligations. It is obvious that those laws by which the inhabitants of great nations are united together have derived their origin from the same social propensities, and the same common principles of association, on which society was originally formed.

The *desire of superiority*, or the principal of emulation, seems merely a modification of the desire of power, or it may be considered as a feeling which prompts us to obtain a greater degree of power than can be possessed by another to whom circumstances or inclination may render it equally desirable. This desire is often accompanied with a feeling of hostility or dislike towards those whom it prompts us to excel, and in this case it is distinguished by the name of envy. The same principle also forms a part of the nature of the lower animals, and, as Mr Stewart remarks, its effects may be traced in the exertion of the horse against his rival on the course. In man, however, in every department of human pursuit, it may be regarded as one of the most powerful springs of action.

*Affections.*—Besides appetites and desires, man is actuated by other feelings called affections, and of these affections our fellow-creatures are always the objects. Affection signifies a fixed inclination of the mind towards some particular object or being, or an excitement of feeling occasioned by the contemplation of the moral qualities of those beings with whom nature and circumstances have allied us. It is distinguished from passion in several respects; the operation of passion on the mind being violent and momentary, that of affection calm and abiding. Passion is excited by the presence or contemplation of the object which has annoyed or gratified us, and subsides when that object is removed; whereas affection is permanent, and gives a bias to the mind as often as the object is suggested on which it operates after others have intervened to occupy the attention and diversify the pursuits. Like the passions, the affections are, to a considerable extent, the springs of action, and produce infinite diversity in the aspect and affairs of human life. But as it appears that man has the power of fixing his affections on particular objects, it is of the utmost importance that he proceed in his choice with judgment and caution, since upon this his happiness essentially depends.

By moral writers the affections have been divided into two kinds, the benevolent and malevolent, according as we may be disposed to promote the happiness or misery of others. To the first belong love, friendship, and gratitude, parental affection, esteem of the wise and good, public spirit, and piety; and to this class enumerated by Dr Reid, Mr Stewart adds filial affection and affection of kindred. But instead of this extended enumeration of affections, some authors have been of opinion, that most, if not all the benevolent affections, may be deduced from parental affection and love.

Parental affection is common to man with the inferior animals. By the operation of the *benevolent affections*, man is admirably fitted to discharge the duties of social life. We are naturally prompted, by parental affection, to provide for a helpless offspring; and it has been remarked, that the affection is always strongest when the object requires it most. Filial affection urges us to repay in manhood those kind offices which we ourselves experienced in our early life, and to watch over the declining years of those who gave us birth, with a tenderness and veneration which the cold deductions of reason could never inspire. Whatever kind offices nature and reason induce us to perform to our parents, affection makes pleasant; and the accomplishment of those tender duties which the circumstances of our condition render it incumbent on us to fulfil, are invariably attended with emotions of delight.

The lower animals very generally manifest parental feeling to a high degree, particularly when attempting to protect their young from imminent danger. The hen, in defence of her brood, has been known to attack a mastiff, and a sheep, in defence of her lamb, to beat off a fox. Experience testifies, that, in man, parental feeling may be weakened, or in a great measure obliterated, by luxury or the immoderate love of pleasure. To this is owing the disgraceful practice of infanticide among uncivilized nations, to which the parents are led by the love of indulgence and individual gratification. In fashionable life this affection is often weakened, if not destroyed, by the prevalence of luxury; in the lower walks it is sometimes obliterated by debauchery; yet the parental feeling operates most powerfully in families where the parents are oppressed with poverty.

In thus briefly pointing out the nature of the benevolent affections, we are irresistibly led to admire the wisdom and goodness of the Supreme Being in implanting principles in the human mind for promoting the interests of society, of which the exercise is attended with as much pleasure to ourselves as utility to those in whose favour they are designed to operate. Love is another affection of the benevolent kind, which induces us anxiously to promote the happiness of the individual whom we tenderly regard; and being always founded on some mental excellence, either real or imaginary, is uniformly accompanied with esteem. This affection may be considered as a powerful stimulus to action, and is productive of the most beneficial effects both upon the morals and manners of mankind. In a rude state of society it excites men to the display of personal bravery, strength, and activity; and in a more civilized state, it stimulates them to mental improvement, tenderness, and generosity, and inspires them with a love of independence, and of all those attainments which are calculated to exalt the mind and to improve the character of man. The mind of the female, in like manner, is improved by the cultivation of all those mental qualities which are calculated to render her agreeable and amiable to the person whom she regards; and in proportion as she is distinguished in civilized life by her mental qualifications, she obtains a more dignified rank in society.

*The malevolent affections*, constituting the second class, are characterised by different appellations. Of these, hatred, jealousy, envy, revenge, and misanthropy, are some of the most powerful. Mr Stewart doubts if any other malevolent principle is implanted in the mind except that of resentment, the others being grafted on this stock by our erroneous opinions and criminal habits. As our benevolent affections are the sources of pleasure, so our malevolent affections can never be increased without inward agitation and uneasiness, which are strongly depicted on the countenances of those whom they influence. This class of affections may be considered as originating from the contemplation of conduct which is offensive to our moral feelings, and which occasions an aversion or dislike far more powerful than such as take their rise from the bodily senses. Moral resentment may be considered as one of the most useful principles of our nature. It is the enemy of vice, and gives to the mind a firmness and tone which render the heart impregnable to its assaults; it becomes the safeguard of virtue, and is justifiable on the same principle as the indignation of the public is against him who violates those laws by which public security is maintained. Anger, when restrained in its operation, is distinguished by the name of resentment; but when it breaks forth with the determined purpose of destroying or deeply injuring the offender, it receives the appellation of revenge. These affections were given us by the Author of Nature to rouse us to vigorous action, not only in our own defence, but in that of others who are injured without protection.

*Passions.*—Passions are strong desires and aversions, but cannot be considered as constituting any new power, being only the inherent qualities of those already mentioned, and to which there has been affixed a different name. The only thing peculiar to them is, that they are excited in a strong degree. Passion, in its original signification, denotes every feeling of the mind produced by an extrinsic cause; but more generally it is used to signify certain emotions of the mind, which induce us to pursue some apparent good, or to avoid some threatened or apparent evil. Among the Greek and Roman writers, passion was commonly opposed to that state of tranquillity in which a man is completely master of himself. It is not, then, an independent principle of action, but a temporary degree of vehemence excited in those dispositions, affections, and desires which are ever present to the mind; and on the proper government and regulation of the passions depends, in a great measure, the happiness both of individuals and of society. The connexion of the body and soul is so intimate, that every agitation of the one has an ostensible influence on the other. The effects which the passions produce upon the human frame are often very surprising; and though at one time they are slow, and almost imperceptible in their operations, and at another are sudden and extremely violent, yet they are at all times equally certain and powerful. Such, indeed, is the influence of passion, that in some individuals extreme joy, or long continued grief, are attended with the most fatal effects; and when these are not immediately produced, violent passions are often extremely injurious to the constitution, by laying the foundation of incurable disorders. Those, therefore, who entertain a just value either for their health or comfort, cannot too strictly watch over their passions and affections, or exercise that authority over them which reason and conscience ought always to maintain. Although the particular manner in which the passions operate upon the human frame has never been fully discovered, yet it must undoubtedly be owing to that intimate connection which subsists

Passions.

between the mind and the body, since whatever injures the one materially affects the other also.

The different passions have external signs or appearances peculiar to themselves, and which express to the beholders, in the most natural language, the various emotions and sensations as they arise in the mind; and hence the character and dispositions of an individual may often be traced in his countenance. These external expressions of the different passions upon the countenance are in some degree visible and comprehensible to all; and in this species of knowledge nature herself is wisely ordained our instructor. Those passions which suddenly prompt men to violence are generally the most conspicuous and alarming in their external expressions. Nothing can be more distinctly displayed in the human countenance than anger and revenge, the distinctive characters of which, as they threaten danger and mischief, frequently excite in the mind of the beholder the passion of fear, which prompts him suddenly to escape the danger. On the other hand, the external signs of distress, although alarming and painful, are nevertheless powerfully attractive; the sympathy and benevolence of our nature often producing the strongest feelings of commiseration, and impelling us to afford relief.

The passions have a wonderful effect upon our perceptions, opinions and belief, and by them most of the opinions we form of the characters of men are influenced. The benevolent and agreeable passions dispose the mind to think favourably of the object, but the malevolent passions the reverse. Gratitude warms the heart towards the friend or child of a benefactor, without observing any peculiar excellence or merit upon which to found our affection and regard. For a further illustration of this subject, see Passions.

*Dispositions* are often put for affections, and denote the particular temper of mind which influences any individual at a particular time, as when we say a man is well or ill disposed to do a particular action. An individual under the influence of good humour, being happy in himself, is disposed to render others happy around him; but under a gloomy or morose disposition the reverse is the case. Some parts of our dispositions or tempers are acquired, and it is in our power to change them. Every individual has some peculiarity of temper which forms a leading feature in his character, distinguishing him from others, as gentle or violent, artful or candid, bold or timid, gloomy or cheerful. This bias in the mind has obtained the name of disposition, and is somewhat different from a principle which constitutes a part of our common nature. Propensity being a principle as well as a disposition, is applicable to both.

*Reason.*—It may be inferred, from what has now been said, that while our appetites, desires, affections, &c. directly point to particular ends, the attainment of which is conducive to happiness, it is the province of reason to discover the means of enjoyment. Man is forcibly led by his feelings to desire certain gratifications; but his mere feelings cannot decidedly point out the means by which the end may be most effectually attained. Reason, instructed by experience and example, directs him to these means; and the mind thus perceives that the means of obtaining the gratifications we thirst after are well defined, though varied, and that they must on no account be neglected or abused. By some, reason is considered the comprehension of many principles which the mind successively can conceive, and from which conclusions may be drawn; while by others it is thought to be no other than the understanding itself considered as it discourses. According to Mr Locke, reason consists of two distinct faculties,—sagacity, whereby it finds intermediate ideas, and illation, whereby it so orders and disposes of them as to discover what connexion there is in each link of the chain by which the extremes are held together, and thereby, as it were, draws into view the truth sought for. "Sense and instruction," he farther observes, "reach but a little way; the greatest part of our knowledge depends upon deductions and intermediate ideas." Influenced by this power, we take a retrospect of the past, and look forward to the future, and thus form an estimate of the real and comparative value of objects. This principle, which so admirably distinguishes man from the lower creation, enables him to compare several ideas together, and to deduce consequences from the relations they are found to bear to one another. Reason alone can shew us the obligation to obey any law by comparing the different results of obedience and disobedience, and induce us to adopt the course most likely to insure the most desirable ends.

Conscience.

*Conscience* is another governing principle, which approves of particular actions, or such as are in themselves good, and condemns those of an opposite quality. By some it has been denominated the moral sense or the moral faculty, and is conceived to be an original faculty in the mind, which, when unbiassed, decides at once respecting the propriety or impropriety of human actions. The ancient philosophers viewed conscience as an ultimate and not an inferential principle, and many modern writers have considered it in the same light. This internal monitor acts with such rapidity and force, that the emotions it excites supercede all the tardy operations of reason. When enlightened by knowledge, and influenced by reason, conscience may be safely trusted on all occasions, but not otherwise. Every man, however, ought uniformly to act to the best of his ability, according to the dictates of conscience, which, in proportion as it is well-informed, must the more effectually prove a safeguard to moral rectitude. This principle, indeed, may be regarded as the source of all virtuous actions, inasmuch as, without its positive intimations, there would be little or no distinction between virtue and vice, and, consequently, nothing left but a selfish calculation of the consequences that may affect our present interests. In all discussions, therefore, respecting right and wrong, it is appealed to as an incorrupt arbiter. Conscience being expressly directed to the examination of our feelings and actions, influences our happiness or misery in an extraordinary degree. When the general tenor of our conduct accords with the dictates of virtue, we enjoy the highest degree of happiness of which we are susceptible;

but, on the other hand, self-condemnation wrings the heart with such pangs of remorse as no language can possibly express. The sovereign power of conscience over the soul of man is derived from the solemn impression that we are ever in the presence of God, to whom we are accountable for our actions as well as our thoughts and designs; and this is clearly the legitimate foundation of its operations.

Those who consider the moral sense as an innate principle, maintain that mankind invariably approve of benevolence, fidelity, and gratitude, and condemn the contrary; and that the notions entertained by mankind in general, respecting these, universally agree. The question, whether this be an innate principle, or the result of early and deep rooted associations, has long been disputed by philosophers, and some of them have certainly carried their arguments to unadvisable extremes. Some have affirmed that in the discovery and enforcement of moral duty reason has no concern, and that man is guided merely by sentiment. Now, if it be admitted that this is really the case, does it not follow that virtue and vice must occasionally change their nature according to the particular circumstances in which men are placed? Those, indeed, who maintain this doctrine, argue that virtue and vice have nothing permanent in their nature, and that, so far from the notions of mankind respecting them being uniform and general, there is scarcely any vice in any age or country which has not, at some period, been countenanced as a virtue. In different ages and countries, sentiment or opinion has undoubtedly approved of very different practices in very similar circumstances. Thus it is generally esteemed an act of piety in children to support their aged and infirm parents; but in some barbarous nations it is deemed an act of mercy, when they become old and feeble, to put them to death. Such as maintain that our duty is pointed out and enforced by mere sentiment, allege that in one country suicide is looked upon as heroism, and in another as felony; that theft, which is usually punished as a crime, was, in ancient Sparta, under certain circumstances, approved of, and rewarded; that duelling, even in this country, is applauded by some, while by others, and by the municipal law, it is condemned; that forgiveness of injuries is accounted meanness by some, and by others magnanimity; that want of veracity, in some cases, is excused towards an enemy or a madman; and that, sometimes, particular promises may, from a change of circumstances, cease to be obligatory, or even lawful.

As instinct invariably directs the inferior animals in all situations and at all times, so we may suppose it would uniformly prompt man in a state of nature to the performance of the same actions in similar circumstances. But though, no doubt, well adapted for the state of nature, instincts are evidently insufficient to guide man in the various and complicated concerns of refined society. It appears, indeed, that mere sentiment would, of itself, be an inadequate guide to the practice of virtue in every particular circumstance in which man may be placed; and, consequently, that those writers who consider the moral sentiment as referable to habit and the effects of education, without allowing any part of it to nature, hold forth a very erroneous and even dangerous opinion. Such persons hesitate not to affirm that benevolence, friendship, and patriotism, are all a delusion, and that every individual, however he may seem or affect to promote the welfare and happiness of mankind, is at bottom actuated entirely by interested motives. But in opposition to so illiberal a view of human nature, it may be remarked, that, exclusive of all considerations of self-interest, we uniformly praise and admire the benevolent and magnanimous actions of individuals; and in whatever age or nation men of great and generous character may have lived, their ennobling virtues at once excite our warmest approbation. Let it be observed, then, that were there no instinctive feeling or sentiment impressed on the mind, which, independent of any sinister motive, makes us feel pleasure in the happiness of others, it were impossible to account for such a uniformity of opinion among men. To this purpose are the words of Mr Hume: "What interest," says he, "can a fond mother have in view, who loses her health by her assiduous attendance on her sick child, and afterwards languishes and dies of grief when freed by its death from the slavery of attendance. Have we no satisfaction in one man's company above another's, and no desire of the welfare of our friend, even though absence or death should prevent us from all participation in it? Or, what is it commonly that gives any participation in it, even while alive and present, but our affection and regard to them." Sentiment is instinctive only in so far as it excites us to benevolence, and induces us to promote the happiness of others, without, however, pointing out the means by which this is to be accomplished. It is the business of reason to instruct us in this particular, and as soon as the proper means have been discovered, this principle will immediately convince us that we are bound in duty to pursue them. In a word, the passions and affections impel men to act, and the governing powers of conscience and reason restrain the impetuosity of these, keep them within proper bounds, and direct them to proper ends.

We have thus considered the active powers of man,—the principles of his nature, which constitute his character, and influence the whole of human conduct, on the proper regulation of which his happiness depends.

### Of Happiness.

Happiness, in a relative sense, signifies the quantity of enjoyment of any thing which is considered good; and the felicity of an individual is estimated according to the good he enjoys, whether it be real or imaginary. Absolute happiness implies pleasure unalloyed with pain, the lasting enjoyment of good without any mixture of evil, or a condition wherein every wish is fully realized. In general it may be observed, that happiness does not consist in greatness, rank, or elevated station, since this superiority can only yield satisfaction where there is competition, and since the anxiety of the pursuit and the pain of disappointment often exceed the pleasure of success. Neither does happiness consist in a total exemption from pain, from care, from business, and the like; such a condition being not unfrequently accompanied with imaginary evils and distresses, which are equally afflicting as real ones, and seldom admit of any relief. Nor can happiness be expected in the mere gratification of the sensual appetites, as these commonly lose their relish, and continue but a short time, or become indifferent as they grow habitual. Happiness, of that mixed kind which it is the lot of mankind to enjoy, consists in those pleasures that are most permanent, and depends on health, on virtuous habits, the exercise of the social affections, the endearing society of kindred and friends, and on the pursuit of some engaging object, which relieves the mind from intolerable vacuity, and gives the individual something to interest him and to hope for. Strictly speaking, any condition in which the amount of pleasure exceeds that of pain, may be said to be happy, and upon this excess depends the degree of happiness. When men express what human happiness consists in, they usually mean the greatest portion of happiness which is attainable in the present state of existence; and, with respect to this world's happiness, it is worthy of remark, that no advantage appears to be enjoyed by vice over virtue, and that among the different orders of civil society it is distributed with remarkable equality.

In his pursuit after happiness, man enjoys many delightful sensations by means of his external senses. The objects which afford him pleasure are denominated good, while those which occasion pain are called evil. Besides those objects which yield us immediate pleasure, and which we therefore call good, there is another kind infinitely superior, which we call moral good. Natural good consists in those pleasures which are suited to the peculiar senses to which they are adapted, and moral good consists in the proper conduct or due regulation of the several appetites and passions in regard to their respective objects. Our appetites and affections naturally lead us to pursue certain objects as our ultimate aim of action; and when these objects are pursued on their own account, they are called ends; whereas, when they are only subservient to the attainment of something else, they are called means; so that means and ends may be considered as the principal ingredients of human happiness. As man has many sources of gratification, and consequently numerous objects of pursuit, he is prompted, by a law of his nature, to seek after every kind of good from which he is capable of deriving enjoyment. In the great variety of ends or goods which may be considered as the ingredients of happiness, there is a material difference, and an obvious subordination; and these goods, or means of happiness, have been divided, by writers on morals, into goods of the body, goods of fortune, and goods of the mind.

Goods of the body hold the lowest rank, and are common to us with the inferior animals. Such are bodily health, strength, agility, hardiness, cleanliness, and decency. The uninterrupted enjoyment of these is a constant source of pleasure and delight, and enables us to support the various disappointments and ills of life with courage and firmness. The enjoyment of the goods of the body depends in a great measure on proper habits and regular exercise.

The goods which hold the second rank are fortune, fame, power, or whatever is considered influence among men. These are estimable chiefly as the means to a farther end, the attainment of the immediate objects of enjoyment for ourselves or others. To love and pursue them on their own account, and not as the means of extensive usefulness, would be absurd, as no accession of them could be deemed sufficient to satisfy the possessor. The miser regards wealth merely on its own account, and, having no other end in view, his object becomes culpable; nor can the accumulation of riches ever yield any real enjoyment, for he "that loveth silver shall not be satisfied with silver, nor he that loveth abundance with increase."

Greatly superior to all other goods are those of the mind, consisting in knowledge, memory, judgment, taste, sagacity, and whatever can be denominated intellectual virtue. These we ought ardently to cultivate, as they constitute in every rational being the most essential ingredients of happiness. Man being formed by nature for intellectual improvement, his felicity greatly depends on the cultivation of the powers of his mind. Besides the pleasures resulting from the cultivation of these powers, the exercise of them on the objects with which they are conversant will always afford a most refined and rational delight. Thus poetry, painting, sculpture, music, and architecture, are peculiarly pleasing, while at same time they are of vast utility; and he whose taste is happily formed for such delightful enjoyments, can never be destitute of a proper subject to occupy and invigorate the mind. For the gratification arising from intellectual attainments and pursuits, the contemplative have been known to abandon every other source of amusement and occupation, to retire from the busy world, and to seclude themselves from the joys of social life. Nay, so highly do some moralists rank intellectual wealth and the exercises of the mind with which it is inseparably associated, that they deem happiness itself subordinate to this element in its composition, for reasons certainly somewhat paradoxical and incomprehensible. Those goods which chiefly promote human happiness are the moral goods of the mind, as they regard ourselves. Such are prudence, fortitude, magnanimity, resignation, the love of God and of virtue,—all which tend to secure the approbation of our own consciences, and to render us amiable in the sight of heaven and our fellow creatures. The proper exercise of these constitutes virtue, or, as it is termed in the schools, the chief good, or *summum bonum*.

Endowed, as man is, with such noble powers and faculties of mind, it seems impossible that his happiness can continue stationary. His exalted, although imperfect nature, ever admits of progressive degrees of improvement short of absolute perfection; and consequently he cannot, at any period of his existence, be considered as having reached the highest state of perfection or of happiness, or as being so happy as to exclude greater degrees of felicity. Subject as he is to numerous wants, and susceptible of various pleasures, many things must unite to promote his happiness; and indeed the perfect enjoyment of the several pleasures which are adapted to his nature, is only to be attained in a more exalted state of being. In a state of virtue, however, the most refined and lasting enjoyments which in this life can gratify the heart of man may be uniformly experienced.

### Of Virtue.

Virtue is an abstract term, which implies some moral excellence or habit, and is employed to express the faithful performance of all those duties incumbent on man in the various relations of his condition. From its original import, it seems to indicate the difficulty which frequently attends the performance of duty. Indeed, were man not liable to temptation and capable of doing wrong, he could not be considered as a moral agent; for in that case his obedience would not in value exceed that which proceeds from the natural impulses of the lower creatures. It is by his being capacitated to distinguish good from evil, that he can form a proper estimate of virtue, and that he perceives the dignity of his moral and intellectual nature.

Many different opinions have been entertained by philosophers respecting the nature of virtue; some contending that it consists in acting according to reason, which approves or disapproves of our conduct, and others that it derives all its value and excellence from obedience to the will of God. Virtue is only applicable to the actions of beings possessed of conscience or the moral faculty. A horse may carry a man from a perilous situation in the field of battle, or a monkey may cast a stone at his keeper and kill him; but these actions are not to be considered either as virtuous or vicious. He who, as a moral agent, performs an action must not only be possessed of reason and understanding, but must likewise be free and have some end in view; because, if he acts under compulsion or restraint, or without foresight or design, he can deserve neither praise nor blame, and consequently his action can be considered neither virtuous nor vicious. Thus, if a person, in attempting to take away another man's property, take away only his own by mistake, he is equally guilty as if he had perpetrated the crime he intended.

Virtue and vice depend on the will, which is regulated by the understanding and by conscience. Philosophers have differed in opinion whether the will and understanding or the affections and dispositions are the most permanent in their operations, and best calculated for forming the human character. Respecting the notion that virtue is seated in the affections, it may be observed that they cannot properly be considered as a criterion of virtue, seeing they are frequently involuntary and transient, and are often transferred from one object to another; and with regard to the dispositions, these are likewise variable at different times, and according to particular tempers. Hence the will appears to be more steady and uniform, and better calculated for the regulation of the conduct and the advancement of virtue. Be this as it may, however, virtue or vice must be considered as qualities of the agent, since we regard the actions where the benefit or injury has entered into the intention of the agent not only as advantageous or hurtful but as right or wrong; and, accordingly, certain distinctive emotions of approbation or disapprobation are felt towards the individual who has performed them.

To render an action virtuous or vicious, it must proceed from a motive. Motives are objects presented to us which in themselves, strictly speaking, are neither virtuous nor vicious, but which determine our choice, and are equivalent to intention in the agent; and hence a question in morals has arisen, whether an agent influenced by motives can be looked upon as acting from necessity. Before proceeding further, therefore, in our discussions respecting the nature of virtue, it may be proper to consider how far man, in his present state, can be considered as a free agent, which leads us to notice the question of *liberty and necessity*.

It is an important fact in the science of morals, that every individual is capable of forming distinct notions of right and wrong, which notions have a powerful tendency upon our conduct, exciting us to the practice of what we approve, and deterring us from that line of conduct which we condemn. On this ground alone, man is considered an accountable being, or, in other words, a moral agent. If, when two actions are presented to him, he has the power of making a choice, he is then to be regarded as a free agent; but the performance of any act not voluntary, but by constraint, can attach neither praise nor blame to the agent. On this difficult controversy, which has been discussed in almost every system of moral science, and which, after all, is but an ingenious logomachy, in which the subject of dispute vanishes when the parties have adjusted their definitions, the opponents mutually accuse one another of holding out encouragements to irreligion and immorality, and of removing the safeguards of virtue. This no doubt must, in a great measure, be owing to the different ideas they affix to the terms in which their propositions are stated. The one conceives it essentially necessary to the freedom of human actions that the will should have the power of determining for itself in the performance of any action, good or evil; whilst the other asserts, that although the will may determine an action, it is nevertheless itself determined by motives. The former of these propositions comprehends the doctrine of liberty, and the latter that of necessity. Those who support the doctrine of liberty, represent that of necessity as subversive of all moral responsibility, as completely destructive of virtue, and altogether incompatible with the idea of rewards and punishments. According to this doctrine, if a man perform a good action, yet it is alleged that he can acquire no merit thereby since he was obliged to do it, and that in the same manner an evil action is not deserving of disapprobation. But although such a conclusion may perhaps be justly drawn from the doctrine as stated by Hobbes, yet it is nevertheless vindicated from all such charges by Leibnitz and Edwards, particularly the latter, who, in his illustrations, argues that the advocates for liberty, by their system, actually involve the same evil consequences of which they accuse their opponents: for if the will is influenced by reason or the determination of the understanding, or by that which appears most desirable, it is not free; and if it be not influenced in this manner, it determines unreasonably. According to the ideas entertained by the advocates for liberty, a moral agent who is perfectly wise and good, and who cannot possibly will what is wrong or evil, is thus brought under a necessity incompatible with virtue, and altogether subversive of moral responsibility. On this interesting subject, Dr Clarke observes, that "this is a necessity not of nature or of fate, but of fitness and wisdom, a necessity consistent with the greatest freedom and most perfect choice; for the only foundation of this necessity is such an unalterable rectitude of will and perfection of wisdom as makes it impossible for a wise being to act foolishly. Though God is a most perfect and free agent, yet he cannot but do always what is wisest and best upon the whole. The reason is evident; because perfect wisdom and goodness are as steady and certain principles of action as *necessity* itself; and an infinitely wise and good being, endued with the most perfect liberty, can no more choose to act in contradiction to wisdom and goodness, than a necessary agent can act contrary to the necessity by which it is acted; it being as great an absurdity and impossibility in choice for infinite wisdom to choose to act unwisely, or infinite goodness to choose what is not good, as it would be in nature for absolute necessity to fail of producing its necessary effect."

Those who advocate the side of liberty maintain that the doctrine of necessity renders ineffectual all admonitions, threatenings, promises, and means of every kind; whilst their opponents at the same time contend that this scheme of liberty is productive of precisely the same effect; for if motives do not influence, promises and threatenings, and means of every kind, must be altogether unavailing. Mr Locke observes upon this subject, "'Tis not a fault but a perfection of our nature to desire, will, and act, according to the last result of a fair examination. This is so far from being a restraint or diminution of freedom, that it is the very improvement and benefit of it; it is not an abridgment, it is the end and use of our liberty; and the farther we are removed from such a determination, the nearer we are to misery and slavery. A perfect indifference in the mind, not determinable by its last judgment, of the good or evil that is thought to attend its choice, would be so far from being an advantage and excellency of any intellectual nature, that it would be as great an imperfection as the want of indifferency to act or not to act, till determined by the will, would be an imperfection on the other side. It is as much a perfection, that desire, or the power of preferring, should be determined by good, as that the power of acting should be determined by the will; and the more certain such determination is, the greater the perfection. Nay, were we determined by any thing but the last results of our own mind, judging of the good or evil of any action, we were not free, the very end of our freedom being, that we might attain the good we choose; and therefore every man is brought under a necessity, by his constitution as an intelligent being, to be determined in willing by his own thought and judgment what is best for him to do, else he would be under the determination of some other than himself, which is want of liberty: And to deny that a man's will in every determination follows his own judgment, is to say that a man wills and acts for an end he would not have, at same time that he wills and acts for it."

There can be no doubt that every man in his conduct is influenced by motives; and were it possible to suppose that a person would do otherwise, he could no longer be considered as a rational or moral agent. Experience indeed shews that the mind upon all occasions is more or less influenced by instinct, passion, education, habit, and prejudice, and in this case the liberty of indifference is destroyed, and along with it liberty itself. It is to be observed upon this subject, that a material difference subsists betwixt *physical* and *moral* necessity. Were the mind unavoidably influenced by physical necessity, or, in other words, were the temptations so strong as to become *absolutely* irresistible, this would not only exempt the individual from all moral responsibility, but would likewise make God the author of sin. So far, however, is this from being the case, that man, instead of being compelled by a physical necessity to do wrong, is, by the arrangements of Providence, powerfully constrained to the practice of virtue. The admonitions of reason and conscience, and the influence of rewards and punishments, all unite to excite him to fulfil his moral duties. The inducements and restraints by which he is influenced are all upon the side of virtue; and therefore no man can allege in truth, that, by the circumstance of his condition, he is unavoidably led to do evil, or that he is impelled by physical necessity to be guilty of sin.

If our wills were absolutely controlled, and if in our conduct we were constrained by physical necessity, there could be no such thing as virtue or vice; nor could man by his actions be the object either of praise or of blame. In the case of *moral necessity* it is otherwise; and even the Deity himself is subject to a moral necessity, since it is impossible for him to do evil, not because this is out of his power, but because a being possessed of infinite wisdom and goodness never can have any desire or inducement to do evil. The further, therefore, that any man advances in the attainment of wisdom and goodness, the nearer does he approach to a necessity of doing good, which, so far from being a defect, advances the individual to the highest perfection that it is possible for him to attain. Those, again, who are wholly influenced by vicious habits, so as to be almost incapable of doing what is right, instead of being excusable on account of this moral inability, are generally looked upon with commiseration or abhorrence.

It appears to be a groundless objection to the doctrine of moral necessity, to say, that it is inconsistent with the use of means; for so far is this from being the case, that there is a necessary connection between means and ends, and between motive and actions, so

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that certain ends are always the consequence of using certain means, and particular actions are the effects of certain motives. With greater propriety may it be said, that the doctrine of liberty supersedes the use of means, since its advocates maintain there can be no necessary connection between means and ends, and therefore the employment of means must be altogether unavailing. The doctrine of necessity, it is to be lamented, has been much abused and perverted. It is no doubt attended with many difficulties,—and there is reason to fear not a few of those who call themselves Christians, ignorantly excuse themselves for their wickedness, through the mistaken views they entertain of the doctrine of predestination. On this question Bishop Horsley makes the following judicious observation: "So far as these necessitarians maintain the certain influence of moral motives as the natural and sufficient means whereby human actions, and even human thoughts, are brought into that continued chain of causes and effects, which, taking its beginning in the operations of the infinite mind, cannot but be fully understood by him; so far they do service to the cause of truth, placing the great and glorious doctrines of foreknowledge and providence—absolute foreknowledge—universal providence—upon a sure and philosophical foundation." The same author, however, being aware how much this doctrine is liable to abuse, and may be carried to an improper length, reminds the advocates on both sides of the controversy, that there is a material difference between moral and physical necessity; and he observes—"But when they go beyond this, when they would represent this influence of moral motives as arising from a physical necessity, the very same which excites and governs the motions of the inanimate creation, here they confound nature's distinctions, and contradict the very principles they would seem to have established. The source of their mistake is this, that they imagine a similitude between things which admit of no comparison—between the influence of a moral motive upon the mind, and that of mechanical force upon matter. A moral motive and a mechanical force are both, indeed, causes, and equally certain causes, each of its proper effect; but they are causes in very different senses of the word, and derive their energy from the most opposite principles. Now, the capacity which force, or an efficient cause, requires in the object of its action, is absolute inertness. But intelligence and liberty constitute the capacity of being influenced by a final cause—by a moral motive; and to this very liberty does this sort of cause owe its whole efficacy—the whole certainty of its operation, which certainty never can disprove the existence of that liberty upon which it is itself founded, and of which it affords the highest evidence." This ingenious author, in vindicating the doctrine of necessity from misconception, and from the pernicious consequences which are supposed to result from it when not sufficiently understood, makes the following distinctions, which are calculated to shew us that man has always the power or liberty of weighing the various motives that are presented to his mind, and that the Deity does not exercise over his will an arbitrary power, so as to render him the passive recipient of external force, and altogether unaccountable in his actions: "The liberty of man and the foreknowledge of God are equally certain, although the proof of each rests on different principles. Our feelings prove to every one of us that we are free; reason and revelation teach us that the Deity knows and governs all things—that even the thoughts of man he understandeth long before the thoughts arise—long before the man himself is born who is to think them. Now, when two distinct propositions are separately proved, each by its proper evidence, it is not a reason for denying either, that the human mind, upon the first hasty view, imagines a repugnance, and may, perhaps, find a difficulty in connecting them, even after the distinct proof of each is clearly perceived and understood."

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The reader who is desirous of becoming fully acquainted with this controversy, is referred to President Edwards' treatise on Free-Will, which is extremely profound, and, perhaps, altogether unanswerable.

From what has been advanced in the foregoing section, respecting the doctrine of necessity, it must be sufficiently obvious, that the mind in its determinations is influenced, not by a physical, but by a moral necessity, which, so far from being inconsistent with the liberty of choice, or destructive of virtue, becomes a most powerful inducement to moral duty. The true doctrine, perhaps, may be thus briefly stated:—Man, being endowed with *liberty* of choice betwixt good and evil in moral conduct, is constrained of *necessity* to prefer that course which, according to the measure of his faculties and the perfection of his moral sense, appears to him preferable to some other line of conduct. This extricates the question from the ambiguities which have been thrown around it, and reconciles the moral responsibility of mankind with the high and everlasting decrees of Providence.

Virtue then, after all, even in consistency with the doctrine of necessity, consists in acting according to the dictates of the moral faculty. Ancient and modern philosophers have said that it consists in acting agreeably to nature; but their illustration of this is very ambiguous, unless they mean acting according to conscience—the vicegerent of God in the human breast. When they say virtue consists in acting agreeably to nature, they do not surely mean acting according to the impulses of the affections or passions, but according to the dictates of the moral faculty, which should rule every other principle of human nature. Every one, therefore, should regulate his actions by this monitor, however little it may be enlightened. We may be blamed for perverting it, but we must be still more reprehensible if we do not obey its dictates. Right and wrong depend not on individual discernment any more than colour or sound depend on the person who perceives them; but, in regard to each individual, they are right or wrong according to conscience, which, ought always to be obeyed.

The seeming differences which have subsisted among philosophers respecting the nature of virtue, is perhaps owing chiefly to the terms made use of not being rightly understood, or properly defined. The three great systems which make virtue consist

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the one in *propriety*, the other in *prudence*, and the third in *disinterested benevolence*, are, in themselves, not materially different; and with one or other of these, all systems of morals necessarily coincide. Virtue, according to the Epicureans, consisted in *prudence*; in the pursuit of private interest—ease of body and peace of mind; and prudence was the means to be adopted for this end. Thus far they agreed in opinion with Plato, Aristotle, and Zeno. Plato considered the soul as a little republic, composed of three different parts, *reason*, the *irascible* and *concupiscible appetites and passions*; and virtue he supposed consisted in the harmony of these three parts. Aristotle made virtue consist in the proper government of all our affections, that is, in habitual *mediocrity*, which he called *propriety*. He considered virtue as a science, consisting in just sentiments and reasonable judgments about what was fit to be done or avoided; and Zeno's system differed only in the degree of self-command it inculcated. Zeno was of opinion that vice was its own punishment, and virtue its own reward; and that the latter consisted in a total apathy and insensibility of human evils. The Eclectics, a later sect than either the Stoics or Epicureans, lived about the time of Augustus, and professing to follow the opinions of Plato and Pythagoras, were called latter Platonists. With them virtue consisted in benevolence. Their opinions were adopted by Drs Ralph, Cudworth, More, Hutchison, Mr John Smith of Cambridge, and others. According to them, benevolence is the sole cause of action in the Deity, and the perfection of human nature consists in resembling that. To one or other of these systems, the opinions of most of the modern philosophers may be reduced. Dr Clarke places virtue in acting according to the *relation of things*; Woolaston in acting according to the *truth of things*; Shaftsbury in maintaining a proper balance of the affections. These, however, are only definitions of the same fundamental idea. Archbishop King considers the opinion of authors respecting virtue as rather imaginary than real; and that "*acting agreeably to nature or reason*, when rightly understood, would perfectly coincide with the *fitness of things*,—the fitness of things, as far as these words have any meaning with *truth*, truth with the *common good*, and the common good with the *will of God*."

There are likewise systems of morals that have been called *licentious*, because they tend to remove all distinction between virtue and vice. Dr Mandeville considers virtue as originating in pride, and represents every passion as wholly vicious which is vicious in any degree; and by means of this sophistry he attempts to establish his favourite doctrine, that private vices are public virtues. He and Rochefoucault consider man as guided entirely by passion and actuated by vanity and selfishness; whence they conclude that virtue is a cheat. Hobbes, again, made virtue consist in obedience to the magistrate, and Hume in utility. The systems now alluded to constitute the most celebrated theories of morals of ancient and modern times.

Notwithstanding the different theories of philosophers, it must be admitted that virtue is, in its nature, simple and unalterable, and that it is consequently the same in every age and country where men have existed in a state of society. Its principles are inscribed on the human heart, so as never to be entirely effaced by error or crime. Of every institution deserving the appellation of law, virtue has been the only sure foundation. Laws, it must be acknowledged, are multiform in their aspect, and not unfrequently equivocal in their tendency. But this apparent defect, which may seem to shake the stability of virtue, must be traced to the circumstances of those nations for whose benefit they were enacted; it affects not the immutability which virtue possessed anterior to all law and independent of it, which shall continue till the principles of our nature be subverted, to modify the character of our actions, and counteract our propensity to crime.

Virtue.

It has been customary with those who deny the immutability of virtue, and who maintain that it is only another term for political convenience, to adduce examples illustrative of the practice of virtue being essentially different in different countries, and criminality and beneficence having been adopted in promiscuous alternation as the standard of excellence. These objections, as we shall endeavour to shew, are more specious than solid. That instances of fraud, injustice, and cruelty sanctioned by the laws, are recorded by ancient writers, cannot be disputed; but this has but a very slender bearing upon the point in question. Our acquaintance with the local peculiarities and political relations of those countries where crime is said to have been protected and encouraged, is by far too limited to enable us to pronounce with decision respecting their moral demerit; and even those features of their national character which to us present an aspect of enormity, may have been softened down into propriety by the existence of circumstances, of which probability is our only evidence. In other words, they may have tolerated the existence of one evil to counteract the effects, or prevent the introduction of a greater; and their conduct is to be attributed less to a predilection for vice than to a mistaken notion respecting virtue. This view can hardly fail to be regarded as correct when we reflect on the conduct and practice of almost every nation in every age and country. The example of those who disregarded the practice of virtue, and of those who reverenced it, prove alike that virtue is essential not only to the prosperity but even to the existence of a nation. In no country of which we have ever heard has vice been considered as an ornament of human nature; and it has been observed, not without just grounds, that even the vicious would employ virtuous means if, in their estimation, they were equally conducive to the attainment of their objects.

Admitting virtue, then, to be a principle of such power, to what source, it may asked, are we to trace those difficulties in which questions of morality are so often involved? If we consider the nature of the human mind, with its various degrees of moral and intellectual capacity, and reflect that reason and passion maintain a divided and complex empire over the minds of all men, we shall cease to wonder how the dictates of duty are obscured or neglected amid the conflicting elements that war within us. We interpret the language of truth under the influence of prejudice, and advance every argument which perverted ingenuity and a mistaken view of interest can suggest, to sanction, in our own case, principles ultimately not less inimical to the happiness of ourselves as individuals, than to that of the community which we design them more immediately to affect. By a selfish casuistry, we introduce perplexity into the concerns of life, with the hope of deriving advantage from the confusion; but the moment we begin to feel the effects of our system, we charge virtue with inconsistency, and complain of that obscurity to which we have ourselves contributed.

It has been maintained by those who support the selfish system, that virtue is indebted for all its charms to the power it possesses of promoting our advantage. That virtue has in general a tendency to promote our interest, and that we regard it, in consequence, with an additional degree of complacency, may no doubt be admitted; but that it is esteemed for this quality alone, we deny. Whilst the homage paid to virtue is universal, history records, and our own experience gives us evidence of the fact, that those whose practice is regulated by its principles are not unfrequently beset with misfortune, when, by adopting a contrary line of conduct, they might command a peculiar kind of success, and be regarded with a smile of approbation by a mercenary world. Nor can it be said, with any regard to truth, that prosperity has ever sanctified vice. The patriot whom treachery has consigned to the gloom and silence of a dungeon, contemplates unappalled, in those recesses of his heart which tyrant power can never reach, the tortures which cruelty may suggest and inflict. His magnanimity must excite the admiration of his own age, and command the approbation of posterity, so long as kindred spirits shall exist to rescue human nature from the imputation of degeneracy; whilst the tyrant who doomed him to unmerited sufferings is regarded as the enemy of his race. The splendour of power avails not to avert or mitigate the ultimate sentence of mankind. No art can extort respect for successful injustice, and no authority suppress the emotions that swell the heart on the contemplation of suffering virtue or insulted patriotism.

The system which supposes virtue to be arbitrary and conventional, and law to be the only rule of right and wrong, cannot reasonably be maintained. This theory seems directly the reverse of the fact; for positive laws, it has been well observed, are only the application, more or less direct, of the law of nature to the particular circumstances of man as a member of society, and the principles of duty must have been coeval with the existence of the race. To what other source are we to trace the enactment of laws? Are we to suppose they owe their origin to chance, and that institutions which have for their object the regulation of human conduct have no reference to the innate principles of those on whom they are designed to operate. We might just as rationally suppose a systematic result to be effected by the fortuitous combination of unconnected bodies, or an effect to precede a cause; and we must either, therefore, admit, that man, in the early stages of society, has acted without a motive, or acknowledge that laws, whose object it is to restrain vice and encourage virtue, evince in our nature a predilection for the one and an aversion for the other, and prove, by this very circumstance, the previous existence of the principles to which they owe their origin.

The very fact of the existence and efficacy of laws, is to us a sufficient proof of their having their foundation in virtue. Laws, indeed, it is admitted, may be enacted according to the caprice of rulers; but it cannot surely be said, that their coercion would be permanent, or their authority acknowledged, by those in whose minds they were associated with an idea rather of force than of propriety and justice. Far from receiving voluntary obedience as a rule of life, they would be regarded as an engine of oppression, and mark the dynasty from which they received their sanctions with the character of despotism. Instead of extending their influence to the heart, and ameliorating the source of action, they would only affect the deportment, and operate in appearance rather than in reality. We have only to suppose, what indeed can exist merely in supposition, a person led to execution, against whom virtue was alleged as a crime, to be sensible of the effect which a law founded on such a principle would produce on the feelings of those who beheld its operation. Supported by force, as it had been enacted by injustice, it might for a time, no doubt, overawe those who felt themselves most deeply interested in its abolition, and effect by fear what it could not accomplish by reason; but what had originated in the caprice of one could not surely operate, in uninterrupted succession, in repugnance to the feelings and interest of millions. That any institution designed to regulate the actions of a nation may operate with proper effect, the principles on which it is founded must find an echo in every breast. In other words, it must promote the general happiness, by counteracting vice and supporting virtue. The principle of every established law, then, must exist, in some measure at least, in the affections of those whose conduct it restrains; nor can we suppose the universal consent of mankind would regard that with affection which tended to their misery; and as virtue can, alone, produce happiness, it is to virtue, therefore, we must refer the origin of laws.

Having considered the principles by which human conduct is regulated, we may conclude that there is no small danger in cherishing false principles, however conducive to convenience, especially as they strengthen our prejudices by blending them with reason. By a principle of his nature, man is apt to regard that system as correct which appears most effectually to promote his interest, or which renders those restraints in some degree unnecessary that are felt to be unpleasant. Thus, the leading principles of action seem to be *expediency and custom*; to these, at least, all the others may be referred.

*Expediency* considers an action in relation to its effect on general happiness. "Whatever is expedient," says Dr Paley, "is right. It is the utility of any moral rule which constitutes the obligation of it." Let it be observed, however, that the expediency of an action, as it is ascertained by the individual who is to perform it, will constitute a fluctuating, and, at best, an inadequate rule of conduct.

Expediency.

If the estimate in reference to this point is to be formed by the generality of mankind, it cannot be doubted but the greater part, judging under the influence of passion or prejudice, will too often, without regard to the general interest, pursue that line of conduct best calculated to promote their own designs. They will hesitate at the moment they ought to act with decision, and weaken by delay, and often lose, that power of action which steady principles alone can impart. It would be difficult to point out a method better fitted than this to preserve in an unenlightened mind an easy conscience under the perpetration of crime. Those actions of Cromwell, for example, though we cannot with propriety suppose the mind of such a man as either weak or unenlightened, which posterity regards with execration, were performed, if we may believe his own testimony, under a decided impression of their expediency. When conscience contemplates the result of an action in uncertainty--when the mind is fluctuating between right and wrong, utility, or rather a false impression of utility, terminates its scruples, and gives sanction to injustice. Were it possible, indeed, for mankind to perceive on all occasions the ultimate tendency of particular actions, the principle of expediency might with safety be admitted, because, in that case, such actions only could be regarded as expedient as were conformable to the will of God; but it is obvious that the greater part of mankind are incapable of perceiving the remote consequences of actions; and even philosophers themselves are more frequently distinguished for the love than for the practice of wisdom. Sages only in retirement, their philosophy disappears in the bustle of life, and the dictates of reason yield to the impulses of nature. Expedience, then, could only operate with success on a nation of philosophers, and even among them the result may be regarded as problematical. Now, it is an acknowledged fact, that mankind in general have no pretensions to the character of philosophers; and, till some grand renovation shall ameliorate the moral aspect of human nature, the principle of expedience can form neither a consistent nor elevated standard of action.

In our inquiries relative to a rule of moral conduct, it will invariably be found, that whatever is most beneficial to society, and tends most effectually to promote our own best interests, both as they respect our present happiness and future hopes, must be infallibly right, and agreeable not only to the light of nature, but likewise to the law of God; and if the experience and knowledge of individuals were so extended as to enable them always to perceive what was most conducive to their own and the public good, this undoubtedly would be the most rational and laudable object of their pursuit; and there can be no doubt whatever of such a doctrine of expediency being perfectly correct. The tendency of all the proceedings of the Deity himself is to promote the general good; and in as far as the tendency of human actions coincides with the plans by which God regulates his government of the universe, so far must such conduct be expedient. It is to be feared, however, that the greater part of the human race limit what they consider expedient to selfish and temporal gratifications; that they overlook what is incumbent on them as rational and immortal beings, and thus consult only their present comfort, at the expense of their future hopes.

Expediency.

Considerations of expediency, if thus limited, cannot be relied on as a rule of moral conduct and a criterion of virtue. Could we by knowledge and experience always ascertain what is just and right, and best adapted for the general good, the line of conduct thus presented would always be most expedient. The duty of man as a moral agent must in every respect be conducive to his best interests, his present happiness, and future hopes; and whatever is ultimately expedient in this extended sense must be morally right. We may, therefore, safely assume expediency as the test of virtue in all cases in which our duty as accountable beings coincides with our own best interests and the general good of mankind. How few, are there, however, who truly understand these interests in all their bearings, and conduct themselves according to this rule? Should individuals always act under the impression that they are to account for their conduct at a higher bar than that of conscience or the opinion of the world, there would be little risk of their being actuated by the inducements of temporary gratification, or of their being influenced by limited views of the doctrine of expediency; and it is only because there are few individuals who act from such extended views and motives that the doctrine of expediency cannot always be relied on as a test of virtue.

It may not be unnecessary here to inquire, how far any one, without a sense of the doctrines of the existence of God and the immortality of the soul, can be really virtuous, even in relation to mankind. When there is no belief of a future state, it cannot be reasonably supposed that any principle exists of sufficient strength to influence our actions, except that of mere selfishness. The individual who discredits the doctrine of a future state of rewards and punishments will, in all probability, reject as chimerical every consideration which extends beyond the narrow span of life, and will avail himself, without regard to consequences, of every opportunity of promoting what he conceives his interest or enjoyment, provided such gratification involve not as a consequence the certainty of some suffering for which the extent of the enjoyment would be inadequate to repay him. It is true that reason, conscience, and the voice of nature, might restrain him; but it is surely rash to suppose that any of these should produce a salutary influence on the actions of him by whom the idea of the God of nature is rejected as a fiction. In consistence with his principles, he cannot recognize the authority of conscience; for any power or principle which counteracts his propensity to immediate enjoyment, if it can be obtained in secrecy and with safety, can only be supposed in his view to originate in feelings of degrading superstition, or to have been devised to accomplish the end of some crafty politician. Neither can it be supposed that reason should be able to restrain the evil propensities of men. A mere knowledge of right and wrong is altogether inadequate to give a practical preference in the one case, or to excite feelings of aversion sufficient for rejection in the other.—

It is only the belief of a future state, in which virtue will be rewarded and vice punished, which can be supposed to add weight to the dictates of reason and conscience.

In concluding our observations on this part of the subject, it may be observed, that morality must derive all its influence over human actions from the belief of a Deity and of the soul's immortality, and that wherever divine revelation is unknown no other principle of action can be safely relied on.

Since man is destined to immortality, the object of all moral enquiries must necessarily be to promote happiness; and it seems unreasonable and pernicious to propose a scheme of morals, in which the interests of immortal beings are regarded only in relation to their mortal existence. Every such attempt would be a virtual disbelief of a future state, or at least would imply an indifference which it seems impossible to justify on any other principles. Morality and religion have generally, indeed, been regarded as different points; but the moral principle, whatever it may be, must be considered as deriving an infinite accession of power and influence from the discoveries of divine revelation; and hence it will be found, that reason and the revealed law of God, instead of counteracting one another, mutually unite together in the establishment of the same great and important results. What a beautiful view does the Christian system lay open to us of the various duties we owe to the moral governor of the world, to society, and to ourselves! How simple, and, at the same time, how intelligible, and admirably adapted to the condition of mankind. How noble and alluring are the examples by which the practice of these duties is recommended; and how powerful are the motives and sanctions with which they are enforced? The scheme of man's deliverance from death, and his final restoration to immortality and happiness,—how wonderful, how benevolent! How unbounded are the prospects which it lays open;—the resurrection of the dead,—the general judgment, and the final establishment of order, peace, and felicity. The plan of redemption which it unfolds, and the hopes which it inspires, how glorious and delightful,—since it discovers to man his future destination, and the means by which he can procure all the assistance he requires for securing to himself the rewards and the triumphs of virtue.

The relations we bear to other beings, evidently constitute the foundation of virtue; and besides the principles of reason and conscience, by which mankind are laid under a moral obligation to fulfil their several duties, there are certain powerful *motives*, calculated to influence the whole of human conduct, strictly connected with this life, which merit serious attention. These motives result from considerations of personal happiness,—the being and providence of God,—and the immortality of the soul.

*Personal happiness.*—Moral obligation respects those actions which are denominated virtuous or vicious. It is our duty to perform the former and avoid the latter, this being the necessary means for effecting a certain end, namely, the end which wisdom points out as deserving of pursuit. Though true wisdom clearly directs that our own happiness should, in a great measure, be left out of consideration if we would attain the highest point of moral excellence, yet doubtless there could be no obligation to any conduct opposed to happiness in the whole. If the consideration of self must be dispensed with on any occasion, it is because our so doing is necessary for the attainment of the highest possible happiness. He who looks not beyond himself, will be apt to complain of many things which befal him as extremely wrong; but when the same person has learned to correct the narrowness of private feeling, and to consider his own happiness as identified with the public good, he will act a very different part. He will regard whatever things befal him as occurring by the fixed ordinations of Providence, and conclude that they must consequently be beneficial in their general tendency, though, in the mean time, distressing to him. Perceiving that true self-love and social are the same, he will view himself as a subject with his fellow men under the same moral government, and so will approve of whatever appears calculated to promote the ends of divine wisdom.

The rules of human conduct are evidently conducive, in the highest degree, to the real interest of man; and it is merely from confounding the motives with the rules of human action, that any misconception has arisen on this subject. The motive and the rule would uniformly correspond, if a wrong bias did not influence human nature; and man would, in this case, experience an infallible rule of rectitude in his own propensities. Owing, however, to the tendency of the passions to excess, the consideration of the effects they produce is the only rule that we can have for the management of them. There is cause of great uneasiness if they are opposed to the dictates of revelation or the light of nature; but we have sufficient evidence to prove that the passions, appetites, or desires, have been legitimately indulged, and directed to proper ends, if the effects produced are morally consistent, while, at the same time, our present happiness is promoted. It thus appears, that by the expediency of the results to which any appetite or passion gives rise, the proper degree in which it should be indulged, may be ascertained. When we have discovered what is best suited for our own and the general good, and calculated alike to promote our present comfort, and our immortal hopes, we feel satisfied that this is an object of rational pursuit, and immediately dismiss every motive that would divert us from the attainment of it; and thus the rule and the motive are brought to coincide. Dr Paley observes, in respect of habitual virtue, that while the good of mankind is the subject, the will of God the rule, and everlasting happiness the motive and end of all virtue; a man shall perform many an act of virtue without having either the good of mankind, the will of God, or everlasting happiness in his thought; and this, he says, is to be understood in the same manner, as that a man may be a very good servant without being conscious, at every turn, of a particular regard to his master's will, or of an express attention to his master's interest; but then he must have served for a length of time, under the actual direction of these motives, to bring it to this: in which service his merit and virtue consist.

Being of God.

*The existence and providence of God.*—Of our own existence we have all the certainty which consciousness can impart, and it must therefore be admitted that our existence has been owing to some cause. This cause must either be dependent or absolute. To suppose an eternal succession of beings whose existence is dependent, involves a contradiction; and it follows, therefore, that the cause on which all things depend must be eternal, self-existent, and independent. Of the attributes and qualities of such a Being, it is difficult for us to form an adequate conception. We may see, however, that this Being must of necessity be infinitely removed from all such imperfections as are inseparable from the properties of the material world, and that he must in his nature be possessed of infinite power, wisdom, and goodness, all of which perfections are demonstrable from this amazing frame of nature which we behold everywhere, above, below, and around us, and to the extent of which perfections no limits can be assigned. When we look upon this beautiful fabric of the universe, we cannot fail to perceive that it is a system which none but a Being possessed of every possible perfection could create, and which nothing inferior to the power that formed it could support and sustain. The Great First Cause must of necessity be possessed of every absolute perfection, he must be eternal, self-existent, infinite, or everywhere present; a being most simple, uniform, indivisible, and incorruptible. From these attributes may likewise be deduced his omscience; for wherever he himself is, his knowledge, which is inseparable from his presence, must likewise be. Of his goodness, as the Great First Cause, the aspect of nature and the administration of his moral government afford ample evidence; nothing but the goodness of his nature could have prompted him to create so many orders of sensitive and intelligent beings, and to endow them with so large a portion of felicity. To the character of a perfect Being, justice is likewise indispensable, to preserve consistency among his other attributes. But the stern and unmitigated justice of a being armed with almighty power, would, to creatures in a state of alienation like us, be a subject of the most terrible contemplation, were it not, that, by his goodness, we are not left without the hope of mercy. Nor need we despair that the same goodness which induced him to give us being at first, will yet, in a manner most conducive to his own honour and glory, restore the virtuous to happiness, and permit, in all their extent, the gratification of those noble capacities of soul with which man has been so bountifully endowed. Had man continued in that state of happiness in which he was originally placed, he might have enjoyed all the good of which his nature is susceptible; yet the proofs of our Creator's goodness would neither have been so strikingly displayed nor so deeply felt by man in any other than his present condition. What enhances our pleasure more than the consideration of our deliverance from pain and misery? Is not the anticipation of immortal felicity rendered inexpressibly more exquisite by the contemplation of our deliverance from that state of suffering to which our apostacy has exposed us? But if the Deity be thus perfect and infinitely good, it may not unreasonably be asked how there should still appear so much suffering and misery among mankind? This naturally leads us to consider the question of the *origin of evil.*

Origin of Evil.

How, in a world governed by so perfect and benevolent a being as God, evil or misery of any kind could ever have been allowed a place, is a subject which, from its inscrutable nature, seems in a great measure to baffle our most eager and diligent researches. The two great objections which apparently militate against the divine goodness, are the evils which God permits in this life and the punishments he inflicts in a life to come.

In respect to the first of these, the evils which happen in the present life, the ancient Persian philosophers, and after them the Manechees, supposed there was an independent evil principle opposed to the infinitely good one, and owing to a continual struggle between these two resulted all that mixture of virtue and vice, happiness and misery, which are so universally prevalent among mankind.

What we call evils in the present life, are the evils of *imperfection*, and *natural* and *moral evil.* The first of these, namely, the evils of mere imperfection, such as the want of certain faculties and excellencies which some other creatures enjoy, cannot, strictly considered, be termed evil. The want of any particular power or perfection in any creature, which never belonged to the species, cannot be considered any more an evil to the individual than his never having been created at all could be termed an evil; for as every faculty and endowment which any creature possesses is the free gift of the Creator, he was under no necessity to confer this gift any more than to give being itself.

*Natural evil* is the necessary result of the former, and to a being on whom immortality was never conferred, death cannot properly be considered as an evil. But if this were even considered as an evil, it is, on the whole, overbalanced by a greater good. Thus the afflictions of good men, if borne with humility, fortitude, and resignation, exalt our nature, increase our knowledge, and improve our virtue; and being in this manner essential to moral discipline, and productive of good upon the whole, cannot therefore be properly considered as an evil; or natural evil may be regarded as a punishment or corrective, which will make it the necessary result of moral evil.

That sort of evil denominated *moral* is the consequence of sin and vice, and arises from the abuse of that liberty originally bestowed on man for the most noble and excellent designs, and which, contrary to the command and intention of his Creator, he abused and perverted to his own corruption and depravity. Even those evils are likewise productive of good, for, while the injuries of the wicked produce in us a dislike to the qualities which prove offensive to us, our patience, meekness, and forgiveness are exercised; and the mind is thus improved, purified, and exalted. The present state of things is thus admirably adapted for the improvement of moral agents. If God be infinitely perfect, then, whatever is, must be right. If uniformly wise and good, of all possible systems he must have chosen the best;

and, consequently, there is no absolute evil in the universe. The different sorts of evil therefore have been introduced into the world without in any way militating against the infinite goodness of the Deity.

In respect to the punishments that are to be inflicted by the Supreme Governor of the universe in a future state, these can be no diminution of his goodness, since adequate punishments are requisite in every good and well constituted government; and since the moral administration of the Supreme Governor will continue in a future state, it is obvious that the punishments of obstinate and incorrigible men will be as necessary to the purposes of his government in another world as they are requisite in this: nor can there be any greater necessity or obligation on the infinite goodness of the Deity to preserve wilful men from future perdition, than to preserve the thoughtless and foolish from personal danger in the present life.

This theory of the existence and origin of evil is strictly consonant to that which has been given of it in the sacred writings, and there are numerous traditions in the history of all nations which bear a striking resemblance to the divine record of these facts. The most ancient account of man's original innocence and happiness, appears to have been derived from the sacred record; and although the knowledge of the particular facts and circumstances attending the fall was preserved among the Jews by being incorporated in their laws, the memorials of it among other nations became in a great measure involved in fable and obscurity. If obedience was first prescribed to man in a state of innocence, he thus became an accountable creature and moral agent, and therefore liable to reward or punishment. But although evil was introduced by transgression, it may notwithstanding be asked, why, under the government of a being infinitely good, was it permitted? In accounting for this, it is only necessary to observe, that had man been excluded from the possibility of sinning, he could no longer have been considered as a moral agent; and had evil been prevented, it must have occasioned the obstruction of some greater good; and hence the origin and the necessity of evil.

If evils, then, upon the whole, be productive of good, as we have endeavoured to shew, it follows, of course, that they cannot properly be considered as evils, and that none of those kinds of evil which have been permitted to enter into the world can be regarded as a diminution or objection to the infinite goodness of that being who created and who governs it.

*The immortality of the soul.*—In regard to the doctrine of the immortality of the soul, three kinds of proofs are adduced, the metaphysical, the moral, and the theological. The first of these are drawn from the nature of the soul, which is simple, indivisible, and uncompounded, and therefore incapable of corruption or destruction of its parts, from its having a power of motion within itself, which, so far as we can judge, depends not upon the bodily organs, and from its powers of memory, penetration, reasoning, and imagination, which are vastly superior to those of matter.

From its indivisible nature, the immortality of the soul is thus maintained by Dr Samuel Clarke: "That none of the known qualities of matter can, in any possible variation, division, or composition, produce sense, and thought, and reason, is abundantly evident. That matter consists of innumerable, divisible, separable, and, for the most part, actually disjoined parts, is acknowledged by all philosophers. That the powers and faculties of the soul being the most remote and distant from all the known properties of matter that can be imagined, it is at least putting great violence upon our reason to imagine them superadded by Omnipotence to one and the same substance, cannot easily be denied. That it is highly unreasonable and absurd to suppose the soul made up of innumerable consciousnesses, as matter is necessarily made up of innumerable parts; and, on the contrary, that it is highly reasonable to believe the seat of thought to be a simple substance, such as cannot naturally be divided or crumbled into pieces, as all matter is naturally subject to be, must of necessity be confessed. Consequently the soul will not be liable to be dissolved at the dissolution of the body, and therefore it will naturally be immortal." The chief prejudice against the belief of the soul's existing thus, and living after the death of the body, maintained by the ancient Epicureans and modern atheists, is this, that they cannot apprehend how the soul can have any sense or perception without the body, wherein, evidently, are all the organs of sense. But neither can they any better apprehend or explain how the soul in the body (that is, the body itself, according to their opinion) is capable of sense or perception by means of the organs of sense. Our conviction of a future state of existence by no means rests on conjecture, but is founded on various positive arguments. But as the nature of the soul, since the first dawnings of philosophy, has been the subject of difficult investigation, and has furnished materials of serious controversy, it is well that so important an article of faith is established on a far surer foundation than what may be denominated the subtilties of the schools. The most cogent proofs of the immortality of the soul are those which are deduced from the moral constitution and phenomena of the human mind—the moral attributes of God, and the present course of things.

From the sublime faculties with which the soul is endowed, its immaterial nature, its unwearied activity, its boundless exertion, the vast improvement it is capable of, and the grand discoveries it is continually making, it is but reasonable to conclude that it is immortal. Man is progressive in improvement, and capable of vast attainments. Naturally aspiring, he possesses an insatiable thirst for knowledge, in the pursuit of which he contemplates the heavenly bodies, investigates the earth, and circumnavigates the ocean. Yet with all the assistance he can possibly enjoy in his present state, his prospects are extremely limited in comparison of his desires and intellectual powers. Shall it then be supposed that the capacities and affections which ennoble the human breast were designed by the Creator to be confined merely to our present existence, and that they are never to be produced into a more perfect life, nor to expatiate in the boundless career of immortality? Certainly not. Viewing man as he is circumstanced in the present life, with all his hopes and capacities, we may well exclaim with the author of the *Night Thoughts,* Immortality.

"Eternal day, 'tis that enlightens all;
And all, by that enlightened, proves it sure.
Consider man as an immortal being,
Intelligible all; and all is great;
A crystalline transparency prevails,
And strikes full lustre through the human sphere:
Consider man as mortal, all is dark,
And wretched reason weeps at the survey."

Infinite wisdom and goodness are displayed in all the works of nature; and does not the same providence preside over the moral and over the natural world, and thus "intimate eternity to man?" That the period of existence should terminate with suffering, and that death should be the final event of life, seems inconsistent with divine wisdom and benevolence. Since pain not unfrequently proves subservient to pleasure, and the evils to which we are subjected generally contribute to our intellectual or moral improvement, may we not infer that, instead of the last pang we experience proving the annihilation of our being, our passage into another state of existence resembles our birth into this; that both are unavoidably accompanied with some degree of pain, and that the maturity of the human is but the infancy of the heavenly life? Man, indeed, seems now only in miniature what he shall be in a future state. Suffering virtue and triumphant vice likewise evidently point to a future state of rewards and punishments, in which will be fully developed the wisdom and benignity of God's administration. It is not to be wondered at that, in an imperfect state like this, doubts and fears should sometimes arise in the mind, and overcloud the cheering views connected with the belief of the soul's immortality. The Divine Being has wisely ordered, that the more substantial joys of a future state should be veiled from our eyes in this world. "What," says St Pierre, "should we do, if we could distinctly see that heavenly country where all whom we have most loved reside? If we were assured, by demonstration, that another world exists, I persuade myself, that from that moment every occupation here would cease. All laborious and vain anxieties of this life would have an end. The passage from one world to the other being within the reach of every man, who would stay in this? But nature has covered the path with obscurity, and has placed doubt and apprehension as sentinels."

The serious desire and expectation of a future state of being, and the dread of non-existence which generally affect mankind, seems to be a cogent argument for the immortality of the soul. Whether we judge from analogy or from the moral attributes of God, desire appears to imply the reality of its object; and the conviction of this reality, which has prevailed in all ages of the world, must either have arisen from some divine revelation or from the congeniality of such a doctrine to the principles of human reason. Indeed, Pythagoras, Plato, Aristotle, and many other ancient sages, declare with one voice the excellency and immortality of the soul.

Immortality.

The natural credibility of this doctrine afforded the utmost pleasure and satisfaction to the wisest and most learned in the heathen world, and not only filled them with the most pleasing hopes of what was to come hereafter, but was a mighty encouragement to the advancement of all moral virtue. "Nothing," says Cicero, "shall ever drive me from the hope of immortality; and if this my opinion concerning the immortality of the soul shall at last prove an error, yet it is a very delightful error, and I will never suffer myself to be undeceived in so pleasing an opinion so long as I live." And again, "O happy day, when I shall go to that blessed assembly of spirits, and depart out of this wicked and miserably confused world." When an opportunity was afforded to Socrates to escape out of prison, he declined it, from the doctrine he taught, and in which he firmly believed, "that when the souls of men depart out of their bodies they go two different ways, the virtuous to a place of happiness, the wicked and the sensual to misery." The illustrious Plato also excites men to the practice of all moral virtue, from the consideration of the soul's existence in a future state. "These things," says he, "are nothing either in number or greatness in comparison with those rewards of virtue and punishments of vice which attend men after death." Cicero, in that discourse he delivered to his children, as related by Xenophon, likewise declares his full conviction of the soul's immortality, and his persuasion is, that the soul, when separated from the body, will not likewise become devoid of sense, but "that it should then become most of all sensible and intelligent."

The destinies of our nature evidently point to something more exalted than the mere gratifications of sense, or the enjoyments of this life; and such a conviction should operate as a powerful incentive to moral rectitude. Indeed, the consideration of the immortality of the soul, with future rewards and punishments, seems to form the very basis of morality, and the source of all the pleasurable prospects that are calculated to gladden the heart of a reasonable creature. What can be more pleasing to the virtuous mind than to contemplate the present state as connected with a future one, and every relation in which man is placed as a school of discipline for his affections; every trial as the exercise of some virtue; and the meritorious deeds resulting from both, as introductory to more exalted scenes of action and enjoyment. "To look upon the soul," says the pious Addison, "as going on from strength to strength, to consider that she is to shine for ever with new accessions of glory, and brighten to all eternity; that she will still be adding virtue to virtue, and knowledge to knowledge,—carries in it something wonderfully agreeable to that ambition which is natural to the mind of man. Nay, it must be a prospect pleasing to God himself to see his creatures for ever beautifying in his eyes, and drawing nearer to him by greater degrees of resemblance. How" continues he, "can that person exalt his thoughts to any thing great and noble, who only believes that, after a short time on the stage of this world, he is to sink into oblivion, and lose his consciousness for ever? For this reason, I am of opinion that so useful and elevated a contemplation as that of the soul's immortality cannot be resumed too often. There is not a more improving exercise to the human mind than to be frequently reviving its own great privileges and endowments, nor a more effectual means to awaken in us an ambition raised above low objects and little pursuits, than to value ourselves as heirs of eternity."

MORASS, a marsh or low moist land, which has no descent for the removal of the waters communicated from the higher grounds. See *Draining*, under AGRICULTURE.

MORAT, or MURTEN, a town of Switzerland, in the canton of Bern, seated on a lake of the same name, at the distance of about 12 miles north-east from Friburg, and 16 west from Bern, contains a castle, and is a trading place of some importance. The scenery in the neighbourhood of this town is extremely interesting, and the summit of mount Vuilly commands a most extensive prospect of country, having on one side the vast chain of snowy mountains stretching from the frontiers of Italy to the borders of Germany, and on the other the Jura mountains, extending towards Basle from the confines of Geneva. Morat is remarkable for having, in 1746, sustained a siege against Charles the Bold, duke of Burgundy, in which his army, consisting of 30,000 men, was almost totally cut to pieces. As a monument commemorative of the splendid victory gained over the Burgundian soldiers, a square edifice, in which were deposited the ashes of the slain, stands near the high road in the vicinity of the town.

MORAVIA, a province subject to Austria, including Moravia Proper and Austrian Silesia, which has been annexed to it, is bounded on the south by that empire,—on the north by Silesia, on the west by Bohemia, and on the east by Hungary. It is diversified with mountains, woods, and vallies, and the low grounds are interspersed with bogs and lakes. The more elevated tracts are generally bleak and sterile, but the champaign districts are productive of pasture, corn, flax, hemp, and saffron, as well as wine, fruits, and garden stuffs. This country is well stocked with horses, cattle, sheep, and goats, and abounds in wild fowl, hares, beavers, foxes, and wolves. It likewise contains some marble quarries; and among its mineral productions are amethysts and bastard diamonds, coal, sulphur, lead, and iron. The March and Morawa, which are the principal rivers, afford plenty of trout, perch, eels, and various other kinds of fish. Among the chief manufactures of Moravia are woollen, cotton, and linen goods, iron, glass, gunpowder, and paper; and the imports consist of cotton, wool, silk, and oil. The inhabitants are generally of the Catholic persuasion, and are estimated at 1,681,000. Their language is a dialect of the Sclavonic, differing but little from the Bohemian; that of the nobility, however, is German and French. From this country the religious sect called Moravians, take their name, their doctrines having been first taught here. Christianity was introduced into Moravia so early as the 9th century.

MORAVIAN, or UNITED BRETHREN, called also HERRNHUTTERS, a sect of Christians in Moravia, which had its origin from the Protestants of that country, who in the fifteenth century were influenced, by the reformer John Huss, to renounce the catholic church. The modern Moravians are indebted for their present happy establishment at Betholsdorf to Nicholas Lewis, count of Zinzendorf, who in 1721 permitted a settlement to take place on his own estate in Upper Lusatia. (See HERRNHUTT.) Similar settlements to that referred to have been established in different parts of Germany, Denmark, Holland, Britain and Ireland, as well as in America and the West Indies. In their religious sentiments, the Moravians are liberally disposed. Viewing particular forms as non-essentials, they admit that the kingdom of Christ is not limited to any sect or party. As the main standard of their faith, they profess to receive only the sacred Scriptures, but at same time adhere to the Augsburg confession, and in a great measure approve of the thirty-nine articles of the church of England. The reader who is desirous for further information respecting this sect, may consult Crantz's *Ancient and Modern History of the Protestant Church of the United Brethren*, and *An Exposition of Christian Doctrine as taught in the Protestant Church of the United Brethren.*

MORAYSHIRE, or ELGINSHIRE, a county of Scotland stretching along the shores of the Moray frith, is bounded on the east by Banffshire, on the south by the counties of Aberdeen and Inverness, and on the west by the latter and Nairnshire, and is 40 miles in length and 20 in breadth.

The southern district of Morayshire is mountainous and woody, but the county is generally fertile, producing wheat, oats, barley, and flax, in abundance. It enjoys a mild and gentle climate, excepting in the more hilly parts; and the aspect of the surface is beautiful and interesting. The elevated tracts in the interior abound with cattle, sheep, and goats, the rearing of which forms the main employment of the farmers in that quarter. But, descending towards the sea shore, the county presents much of the agreeable appearance of cultivation. The soil in the maritime district is a rich deep clay, while that of the vallies in the hilly parts is moorish. Agriculture is in a thriving state in Morayshire, though the vapours arising from stagnating streams are sometimes extremely prejudicial to the interests of the farmer.

The introduction of potatoes and of clover into this county, did not take place till about 1740, and coal having been unknown here at that period, peat constituted the principal fuel. Freestone, grey slate, and limestone are plentiful, and form the chief mineral productions yet discovered in Morayshire.

The Spey, Lossie, and Findhorn are the principal rivers. Descending from Badenoch, among the wilds of Inverness-shire, the Spey partly intersects Morayshire, and forms a portion of its eastern boundary. The Lossie, rising among the hills in the upper district, passes the ancient burgh of Elgin in its course to the frith, at its entrance to which it forms the harbour of Lossiemouth; and the Findhorn, taking its rise in the county of Inverness, crosses that of Nairn, and expands into a lake as it flows through this county to the Moray frith. Lake Spynie is worthy of notice, and was perhaps formerly an arm of the sea. It is well supplied with fish, especially pike and perch, and extends three miles in length and one in breadth. The population of Morayshire in 1811 was 28,108, and in 1821 amounted to 31,162.

This county presents many curious objects of antiquity, the most magnificent of which are the ruins of the Elgin cathedral and those of the palace of the bishops of Moray on the south bank of Loch

Spynie. Swino's stone or pillar, between Nairn and Forres, is, in point of workmanship, among the most remarkable of the ancient obelisks of Scotland. It rises to the height of 23 feet, and is supposed to have been raised in commemoration of the peace settled between Malcolm and Canute about the year 1012. The remains of the castle of Lochindross, famous in the ancient history of Scotland, occupy a considerable space on an islet in the lake of Lochindross.—*Elgin,* the county town, has been already noticed.

MORE, SIR THOMAS, Lord high-chancellor of England in the reign of Henry VIII. was born in London in 1480, and educated at Oxford, where he made astonishing progress in academical learning; after which he removed to New Inn, London, for the study of law, and thence to Lincoln's Inn, of which his father, Sir John More, was a member. He commenced his career at the bar in the most promising manner; and having likewise attained no small reputation from his course of lectures on St Augustin, *De Civitate Dei,* delivered in St Laurence church, his eminent talents thereafter procured for him the appointment of law-reader at Furnival's Inn. It is remarkable, that, notwithstanding his taste and rank in life, he was so bigotted in favour of monkish discipline as to wear a hair shirt next the skin, and accustom himself to fasting, and to sleeping on a bare plank. Having been elected a member of Parliament at the early age of twenty-two, he had ere long an opportunity of distinguishing himself in the House of Commons. By his temerity, however, in animating the Commons to reject the king's demand of a contribution for the marriage of his eldest daughter with James IV. of Scotland, he incurred the displeasure of Henry VII. who, piqued at such opposition from a beardless boy, revenged himself on Mr More's father, by sending him to the Tower and obliging him to pay a fine of L 100; and young More therefore found it prudent to seclude himself for a period from public life. But on the succession of Henry VIII. he resumed his practice at the bar; and his ingenuity having influenced that capricious monarch in his favour, he was made master of the Requests, knighted, and chosen one of the privy-council. The appointment of treasurer of the Exchequer was conferred on him in 1520, that of speaker of the House of Commons in the succeeding year, and he was next constituted chancellor of the duchy of Lancaster. In such estimation, indeed, was Sir Thomas held by the king, that he not only bestowed upon him the highest honours and preferments, but treated him with every mark of cordial regard, and chose not unfrequently to enjoy, in a private manner, at Chelsea, the pleasures of his domestic society. In how judicious a manner these intoxicating instances of royal favour were estimated by this excellent statesman is finely evinced in the following anecdote. King Henry having once dined with Sir Thomas, walked with him nearly an hour in the garden with his arm round his neck. After he was gone, Mr Roper, Sir Thomas's son-in-law, observed how happy he was to be so familiarly treated by the king. To which Sir Thomas replied, "I thank our Lord, son Roper, I find his grace my very good lord, indeed, and believe he doth as singularly favour me as any subject within the realm; howbeit I must tell thee I have no cause to be proud thereof, for if my head could win him a castle in France it would not fail to go off."

On the disgrace of Cardinal Wolsey, about the year 1529, Sir Thomas More was promoted to the dignified office of chancellor; the duties connected with which he executed for three years. But in order to avoid the danger to which he must have been exposed in refusing to confirm the king's divorce, he resigned his appointment and retired to his house at Chelsea, where, in reduced circumstances, he employed himself in devotion and study. Notwithstanding this voluntary submission to an unfavourable reverse of fortune, which might have soothed the indignant monarch, Sir Thomas's known opinion of the illegality of the king's marriage with Anne Boleyn, rendered him quite obnoxious to Henry, who therefore determined to effect his destruction. Several false accusations were laid to his charge, and, among others, that of encouraging Elizabeth Barton, the nun of Kent, in her treasonable practices, which, upon trial, proved ineffectual; but, refusing to take the oath enjoined by the act of supremacy, he was, in consequence, imprisoned in the Tower, where he remained about fifteen months, after which he was tried for high treason; and although the evidence of his guilt rested solely on the testimony of Rich, the solicitor-general, he was condemned to suffer as a traitor.

Shortly before his execution, an affecting scene occurred between Sir Thomas and his favourite daughter Margaret. Availing herself of the last opportunity of seeing her beloved parent, she had stationed herself for the purpose at the Tower wharf; but when she beheld him proceeding from Westminster-hall to the Tower, with the axe, the emblem of death, borne before him, the sight distracted her, and, regardless of herself, she rushed through the crowd and the guards, and instantaneously clung upon his neck in a paroxysm of despair. The distress was overpowering, and in vain did the heroic man strive to conceal the emotions of his heart, which a falling tear pathetically expressed.

On the 6th June 1535, he was led to the place of execution on Towerhill, while the unfeigned commiseration of the spectators was expressed by silence and tears. In his last moments his deportment was peculiarly becoming. Having concluded his devotions, he laid his head upon the block, and mildly requested the executioner to stay till he removed his beard, which, he remarked, *had committed no treason.* He thus died in the 56th year of his age, and his body was first interred in the Tower, and afterwards deposited by his daughter, Margaret, in the chancel of the church of Chelsea, where his monument, bearing an inscription written by himself, is still to be seen. His head, after being exposed fourteen days upon London bridge, was likewise procured by his daughter, and placed in a chapel near St. Dunstan's in Canterbury, in a vault belonging to the Roper family. The character of Sir Thomas More, both in private and public life, was singularly virtuous and worthy of imitation. In the education of his daughters, particularly, his example was admired and followed by all the nobility and gentry of the surrounding neighbourhood. He wrote several works, the most celebrated of which is his Utopia.

MOREA, the ancient Peloponnesus, already described under GREECE. It forms the south-east part of Turkey in Europe, being united thereto by the isthmus of Corinth, which lies between the gulf of Lepanto and that of Engia. In length it extends 120 miles, and in breadth 110: and being well watered, and favoured with a temperate climate, the soil is generally productive, excepting in the mountainous tracts which occupy the middle of the country. The Morea abounds in mulberry trees, and probably derives its name from that circumstance. The principal rivers are the Potamo, Alpheus, Vasili, and Stromio, but there are many others of inferior note. Tripolizza is the capital.

This country was, in 1687, wrested from the Turks by the Venetians, but was retaken in 1715. In 1770 the inhabitants, induced by the promise of aid from Russia, made an ineffectual attempt to rid themselves of Turkish despotism, and thereby only subjected themselves to the vindictive tyranny of their oppressors. The same spirit, however, which actuated them at that period has ultimately stimulated to still greater exertions; and it is anxiously to be hoped that this far-famed country will, ere long, be restored to independence, though the event of the sanguinary struggle yet remains undecided.

MORESQUE DANCE, vulgarly called Morrice Dance, was derived from the Moors, and probably introduced into England about the commencement of the sixteenth century. It is performed by a number of young men in their shirts, and having bells at their feet, and ribbons of divers colours round their arms and across their shoulders.

MORESQUE, or MORISKO, a sort of painting or carving imitated from the Moors, and which consists of a number of grotesque pieces and compartments intermingled indiscriminately, containing a coarse resemblance of beasts, birds, trees, and the like. These are more especially used in damask work and embroideries.

MORGANA. See FATA MORGANA.

MORIAH, an eminence in Jerusalem, where, it is supposed, Abraham went to immolate his son Isaac, and likewise where Solomon's temple was founded. By means of a bridge and gallery, it was connected with mount Sion, of which it may be viewed as forming a part.

MORILLES, a kind of agaricus or mushroom, pierced with holes like a honeycomb, and of the size of a walnut, is made use of in sauces and ragouts, being considered as restorative and good for creating an appetite.

MORLACHIA, a mountainous country of Dalmatia. See DALMATIA.

MORNING is, by the astronomers, reckoned from midnight to mid-day; but, in common language, it denotes the time of sun-rising, or the commencement of day.

MORNING STAR, the planet Venus, so denominated when she rises a little before the sun. See ASTRONOMY.

MOROCCO, the largest and most westerly of the Barbary states, situated between 28° and 36° north latitude, and bounded on the north by the Mediterranean, on the south by the desert Saharah, on the east by the kingdoms of Tremecen, Sigelmessa, and Biledulgerid, and on the west by the Atlantic. Including a great part of the ancient Mauritania, it extends more than 600 miles in length, and from 200 to 380 miles in breadth, and consists of three grand divisions, namely, Morocco, Fez, and Sus. Mogadore, already noticed, is the principal commercial place in the empire.

This extensive region is traversed by that vast chain of mountains which stretches from east to west through the whole length of Barbary, and gives name to the ocean which separates the eastern and western continents. See ATLAS. It presents various capes, the chief of which are Cape Threeforks on the Mediterranean, Cape Spartel at the entrance of the straits, and Capes Rajadore, None, and Cantin on the Atlantic. There are two bays, that of Tangier in the straits of Gibraltar, and that of Tetuan in the Mediterranean. The chief rivers, besides the Malva, or Mulvia, which, rising in the deserts, runs from south to north dividing Morocco from Algiers, are the Suz, Rabbata, Ommirabih, Larache, Tansift, Gueron, Darodt, and Sebon.

Sheltered from the east winds by the Atlas mountains, the lofty summits of which are ever covered with snow, Morocco enjoys a tolerably healthy climate; and, being watered by numerous mountain streams, while the rains are regular in winter and the dews in the hot season, great fertility is communicated to the soil, which consequently yields abundance of the gifts of nature. The inland parts are more especially covered with fruitful verdure, and adorned with flowers; and the soil on the west coast, being light and stony, is less adapted for the growth of wheat than for the cultivation of the olive and vine. In this country all the fruits are remarkably early, the vintage, even in the froward seasons, being over in September; but the harvest is sometimes blasted by heavy rains, and, what is worse, by great drought, which favours the rapid increase of desolating locusts, whose ravages spread famine over the land. Though the fertility of the soil constitutes the main wealth of Morocco, the indolence of the natives in cultivating their fields, arising, however, not a little from the insecurity of their possessions, impedes very much the prosperity of the country. The produce consists chiefly of corn, fruits of various kinds, flax, wax, gums, and live-stock. In the extensive plantations of fruit-trees, are produced dates, pomegranates, oranges, lemons, melons, figs, apples, pears, and apricots; and, in the vineyards and gardens, the Barbary fig, or prickly pear-tree, forms impenetrable hedges. In the southern provinces the palm tree is common, and towards the coast of Sallee and Marmora are considerable forests of oak.

In the deserts of Morocco, lions, tigers, leopards, hyaenas, and serpents are numerous; but the elephant and rhinoceros are unknown. Bears, porcupines, foxes, hares, apes, weasels, chamelions, and almost every species of reptile, are found; and, besides the locust, the insects most remarkable are the large cricket and the ammoniac fly. The domestic quadrupeds are camels, horses, cattle, sheep, asses, mules, a very useful species of which is propagated between the ass and cow, and employed as a beast of burden. Among the wild fowl, which are numerous on the coast, eagles, hawks, partridges, and quails are frequent. On the western shores all those kinds of fish usually found in the Mediterranean are prevalent, and whales have been likewise sometimes observed; but the most remarkable fish, which is peculiar to this coast, is that called *izgal*, and which, when thoroughly dried, constitutes a great article of trade in the inland parts of Africa.

Mines of copper are wrought in the mountainous parts to the eastward of Morocco, and there are also iron as well as copper mines in the province of Sus. These metals are, however, but sparingly obtained in Morocco, and the natives usually import iron, notwithstanding the enormous duty to which it is liable. Several mines of gold and silver are said to be under the interdict of the emperor, who, as the Moors assert, thus prevents them from obtaining the necessary means to enable them to shake off their yoke. In the mountains, also, some gold is found intermixed with antimony and lead ore.

The trade of Morocco, which is chiefly monopolised by Jews, though there are likewise some Christian merchants established upon the coasts, is conducted by means of great caravans, which travel immense journeys through deserts almost void of water. With the joint view of trade and devotion, some of these caravans, consisting of a vast number of camels, horses, and mules, are annually sent to Mecca with a great variety of commodities, among which are woollen stuffs, leather, ostrich feathers, cochineal, and indigo, in return for which, silks, muslins, calico, coffee, and drugs, are received. Caravans are also sent to Nigritia with silk, salt, and other goods, for which negroes, ivory, and gold are brought in return. Besides the extensive weekly markets held in the capital, and the great trade conducted at Mogadore, different European factories are established in the seaport towns. Of the coins current in this empire, the ducat, blanquil, and fluce, are the chief. The ducat is a gold piece, somewhat similar to that of Hungary, and of the value of 9s.; the blanquil is a silver piece, worth two pence sterling; and the fluce is a copper coin, twenty of which are equal to a blanquil. Merchants' accounts are kept in ounces, ten of which make a ducat, though 17½ for a ducat are, it is said, allowed in payments to government. The adoption of scales for valuing the specie has been introduced owing to the liability of the coins to be filed and even clipped by the Jews, who are masters of the mint. The chief manufactures of this country are Morocco leather, silk, cotton, and woollen goods, carpeting and matting, paper, muskets, and gunpowder. Glass making and the method of casting cannon are unknown; and the carpenter's tools, forges, ploughs, looms, and other instruments, are generally of rude construction.

In most towns of the Morocco empire the houses have generally a mean aspect, are flat-roofed, and without windows or fire-places, and the principal furniture within is a mattress, together with a piece of carpeting. The best apartments being in the back part of the edifice, the first place a stranger is introduced into is not unfrequently the stable, where he must wait with patience until the females of the house be removed into a room by themselves, after which he is ushered through a square court, which is usually floored with checkered tiling, and provided with a fountain in the centre; and in an adjoining chamber he is received by the master of the house, who, barefooted and with his legs crossing each other, sits on his mattress. The want of windows is obviated by means of large folding-doors, by the opening of which light is admitted into the apartments, that communicate with the square court.

No government can be more preposterously despotic than that of the empire of Morocco, as the prince maintains an absolute power not only over the lives and fortunes but even in some degree over the consciences of his subjects, he being the only individual who, as successor of the prophet, is duly qualified to decypher the Koran, which, together with the comments on it, contains all the written laws. The whole of the judges are constituted by the emperor, and guided solely by his wisdom or caprice. They are both military and ecclesiastical, the former consisting of the pachas, governors, alcaides, and other officers, and the latter of the mufti and cadis. Inasmuch as these judges are the mercenary tools of the prince, they are the merciless tyrants of the people, who can neither procure countenance nor justice from them but by bribery. The revenue accruing to the emperor from his flagrant oppression of the subjects is immense. As sole heir of his people, he is authorized to seize upon their effects as he thinks proper. But a principal source of his income consists in the tenth part of the cattle and produce of the soil, exacted not only from the natives, but also from the Brebes and Arabs; and, besides this, a tax of six crowns is required from all Jews and Christians above the age of fifteen years. The laws of Morocco are remarkably severe, more especially in respect of crimes committed against the state, which are punished with almost unparalleled barbarity; and sometimes, in these cases, the emperor himself or his bashaws act the part of executioners, by shooting the culprit, or cutting him to pieces with their own hands.

The natives of the Morocco empire being all obliged, in cases of emergency, to appear in the capacity of soldiers, the number of troops at the emperor's command is extremely numerous. Of the regular land-forces, amounting to 36,000, about two-thirds are cavalry, and the royal body-guard consists of 6000 men. In the naval service, the main object of which is piracy, about 6000 men are employed; but the number of small frigates and row-galleys is very inconsiderable.

Morocco is occupied by three distinct classes of people; the Brebes, or Berebbers, a warlike race, of doubtful origin, and confined to the mountains; the Arabs, and the Moors. The Brebes consist chiefly of cafiles or tribes; they speak a language peculiar to themselves, boast of their independence, and entertain great animosity towards the other classes of natives. Being very formidable in their secure and elevated domains, nothing but religious prejudice impels them to pay fealty to the sovereign of the empire; and therefore they throw off the yoke at times without scruple or dread.

The inhabitants of the plains are placed in a state of comparative simplicity, living in tents, and devoting themselves to rural toil. Their encampments, which they call *douchars*, consist of a number of tents situated together in the form of a crescent, or in two parallel lines, and the central space is allotted to the flocks when they are not out at pasture. Feeling their wants to be comparatively few, these contented people enjoy in their native fields, and in the milk and wool of their bleating flocks, the grateful means of food and raiment. The tribes very rarely intermarry, as they are prevented from so doing by serious prejudices. In their dress the natives use neither shirts nor drawers; and the main covering of the females is a long garment called a *haïck*, and composed of white wool and cotton, or cotton and silk woven together. Though doomed to the most servile subjection and toil, the women generally delight in adorning their persons with earings, bracelets, and other trinkets, with all of which decorations they appear even at their usual employment.

The Moors, calling themselves Mooslim, or Believers, while by the Arabs they are denominated *Medanien*, or town's people, are a mixed race, consisting of four separate classes, namely, the descendants of Arab families, the descendants of Negroes, originally introduced into the country as soldiers, and who are styled *Bukharie* or black tribe, the race sprung from the Brebes, and the *Andalusie*, or progeny of the Arab conquerors of Spain. These classes of inhabitants are degenerate and uninformed, but eager after the fanciful science of astrology, and passionately fond of music, in which latter art they have attained a considerable degree of proficiency. They are said to be skilful in managing horses and in wielding the lance. Their language and religion were derived from the Arabs; but so stinted is education among them, that the accomplishments of reading and writing are rare, and seldom are to be found but among the priests and talbes, who are venerated as the honoured depositaries of learning. The amusements of the natives consist principally in the cultivation of their gardens and in the practice of music.

Since the fourteenth century, this extensive country has been nominally an empire. Notwithstanding its manifold natural advantages, commerce has greatly declined, through the impolitic measures of Muley Soliman, who is, however, one of the best princes whom the state has ever enjoyed. Judicious policy and a liberal intercourse with foreign powers are all that are required to augment the wealth and consequence of this kingdom.

*Morocco*, the capital of the empire, is pleasantly situated in a valley, surrounded by a finely diversified country, and having the Atlas mountains on the south-east, and another chain on the north. It is about eight miles in circumference, inclosed by very strong walls, which are flanked with square towers, and encompassed by a wide and deep ditch; and it has various entrances, the gates of which are shut at a certain hour every night. This city presents few attractions, notwithstanding its great extent. The streets are extremely irregular; the houses, many of which are in a dilapidated condition, have a mean and uninhabited appearance; and the squares, caravanseries, public baths, and mosques are more numerous than magnificent. Indeed, the only public structure particularly worthy of notice is the royal palace, on the south-east side of the city, consisting of a considerable group of buildings, squares, and gardens, and occupying a space of nearly three miles in circuit, bounded by a high wall. The chief entrances to this ancient princely residence are formed with Gothic arches of hewn stone, and lead to different spacious courts, which must be gone through in order to approach any of the buildings. So very extensive an establishment is the castle, that of itself it may be almost viewed as a town. It contains a great number of inhabitants, all of whom are in the service of the emperor, and is under the jurisdiction of an alcaide, who is independant of the governor of the city. Morocco is well supplied with water by means of numerous reservoirs, into which the streams in the vicinity empty themselves; and regular markets are held for the disposal of provisions, as well as fairs for the purchase of cattle. A particular part of the town is more especially allotted for the sale of merchandise, and is called the *Elcaisseria*. In this quarter shops are formed in the walls of the houses, about a yard from the ground, and of so moderate a height within as barely to admit of a man sitting in one of them in a cross-legged position. At a former period, when its condition was more prosperous, this city contained more than 700,000 inhabitants; but the population is now greatly reduced by means of wars, pestilence, and other causes. The Jews, being very numerous at this place, have a separate town for themselves, which is walled, and under the government of an alcaide. Morocco is situated 120 miles east from Mogadore, and 340 south-west from Gibraltar.

MOROCCO-LEATHER, so called from the method of preparing it having, as is supposed, originated in the kingdom of Morocco, consists of the skins of goats or other quadrupeds, dressed in a particular manner, and dyed at pleasure. See TANNING.

MORPETH, a borough and market-town of Northumberlandshire in England, is seated on the north bank of the river Wansbeck, at the distance of 15 miles north from Newcastle, and 289 north by west from London. It contains an excellent market-place, a town-house, county-jail, chapel, free grammar-school, and an hospital; and the parish church, together with a castle now in ruins, stands in the vicinity. The population of this town in 1811 amounted to 3244.

MORPHEUS, in mythology, the god of sleep, or according to some, one of the ministers of Somnus, is usually represented in a recumbent posture, and crowned with poppies. The appellation of *the kindest of deities* is bestowed upon him by the poet Ovid.

MORTAGNE, a town of France in the department of the North, formerly a province of French Flanders, is situated at the confluence of the Scarpe and the Scheldt, at the distance of eight miles south-east from Tournay.

MORTALITY, BILLS OF, are proper registers of the annual births and burials, as well as of the marriages, in any parish, town, or district. These registers are of great utility in many respects, but more especially as they furnish the means whereby to ascertain, in some measure, that law which regulates the existence of the human species in different situations, and as they afford important data in calculating the tables on which the theory of life-annuities is founded. See ANNUITIES and LONGEVITY.

MORTAR, a piece of ordnance, made of brass or iron, and which, being thick, short, and wide, is, in the military art, of great use for throwing bombs, carcasses, grape-shot, stones, and the like. Ordnance of this kind were employed in 1653 at the siege of Bremen; and, at the siege of Stralsund, 1675, they were first used for throwing red hot balls. The usual diameters of mortars are eight, ten, and thirteen inches,—the larger kinds, of from eighteen to twenty inches diameter, being now out of use. *Coehorn mortars*, so called after the inventor, Baron Coehorn, are a small sort, of 4·6 inches diameter. Dreadful execution has sometimes been effected by means of a number of coehorns fixed to a substantial bed, at an elevation of 45 degrees. See *Projectiles* under MECHANICS, and likewise WAR.

MORTAR, an utensil of essential use in chemistry and pharmacy, for the division of bodies by percussion, trituration, &c. The substance to be broken in the mortar is pounded or bruised with a pestle made of wood, iron, or marble. Large mortars are usually fixed at a convenient height upon a block of wood; and, when the pestle is large and heavy, it is sometimes suspended by a chain or cord attached to a moveable pole, which is situated horizontally above the mortar.

MORTGAGE, in law, *mortuum vadium*, a pledge of lands or tenements made in respect of money or other effects borrowed. The person who thus grants an estate in fee is called the mortgager, while the creditor to whom it is granted is called the tenant in mortgage, or mortgagee. By this deed, if the mortgager fail of making restitution at the proper time, the estate absolutely departs from him, being forfeited to the creditor. The mortgager, however, retains possession of the said lands or tenements till he fails to make the necessary payment; and then, though the mortgagee enters for non-payment, the debtor has a right to the equity of redemption in the court of Chancery, where he may call the mortgagee to deliver back the estate, and account for the rents and profit, by paying the debt in full with interest, 7 Geo. II. c. 20. But, on the other hand, the mortgagee may either compel the sale of the estate, in order to get the whole of his money immediately, or else call upon the mortgager to redeem his estate presently, or, in default thereof, to be forever foreclosed from redeeming the same, that is, to lose his equity of redemption without possibility of recal.

MORTIFICATION, in medicine, implies the extinction of the natural heat of any part of the body, or that disease wherein the natural juices lose their proper motion, and, by falling into a fermentative one, corrupt and destroy the texture of the part. In a religious sense, the term mortification denotes the ancient practice of penance. It is a term also used in Scotland, to signify the perpetual appropriation of any fund in the endowment of some public institution, &c.

MORTMAIN, *in mortua manu*, the alienation of lands or tenements to any religious house, corporation, or fraternity, and their successors. Any man might, by the common law, dispose at pleasure of his lands to another private individual, especially when the foedal restraints of alienation were worn away. Yet, in consequence of these, says Blackstone, it was always and is still necessary for corporations to have a licence of mortmain from the crown to enable them to purchase lands; for, as the king is the ultimate lord of every fee, he ought not, unless by his own consent, to lose his privilege of escheats and other foedal profits, by the vesting of lands in tenants that can never be attainted or die. By statute of mortmain, 9 Geo. II. c. 36., it is enacted that no lands or tenements or money shall be given for or charged with any charitable uses whatsoever unless by deed indented, executed in the presence of two witnesses, twelve calendar months before the death of the donor, and enrolled in the court of Chancery within six months after its execution, (except stocks in the public funds, which may be transferred within six months previous to the donor's death,) and unless such gift be made to take effect immediately, and be without power of revocation, and that all other gifts shall be void. The two universities and the colleges of Eton, Westminster, and Winchester, are exempted out of this act. A form of bequest for the encouragement of Calvinistic Methodism is to be seen in the Evangelical Magazine.

MORTUARY, in law, was originally a voluntary but afterwards an indispensable bequest to the church, by way of recompence of personal tythes, which, in their lifetime, the laity had omitted to pay. To obviate disagreeable consequences arising from the various customs concerning mortuaries, they were reduced to a certain standard by 21 Henry VIII. c. 6., upon which statute the law of mortuaries remains to this day.

MOSAIC, or MOSAIC WORK, an ancient mode of making paintings, performed, not by the application of pigments, but by cementing small pieces of stone or glass of different colours, so as to give the appearance of pictures. It was commonly employed in decorating the pavement, ceilings, or walls of temples and palaces. The most common mosaics consisted of white and black stones cut square. The mosaics of glass paste were rich and of various bright colours. This art has been occasionally practised in modern times, as in the interior of the cupola of St Peter's at Rome. The subjects that were most usual in this art were grotesque ornaments, in which human figures were introduced. Respecting the true origin of the term mosaic, different opinions have, by the learned, been entertained, but it is most generally supposed to be derived from *musaicum*, or rather *musivum*, the appellation of the art among the Romans. Being an art of very remote antiquity, mosaic appears to have been practised before the introduction of painting, and, in all probability, it was first suggested from observing the beautiful appearance of marble pavements. In the palace of Ahasuerus, there was "a pavement of red, blue, and black marble." Esther, I. 6. This art, which must have been rude and tasteless at first, was, from the Greeks, communicated to the Romans, and brought gradually to a state of perfection in Italy in after ages. A remarkably interesting specimen of ancient mosaic, which originally belonged to the temple at Preneste, was formerly preserved in the palace of the princes of the Barbarini family at Palestrina. It is described by Barthelemy as being in length about 18 feet, and in breadth more than 14 feet. " In the lower part, we perceive the Nile winding round several small islands; boats with oars or sails; Egyptians in pursuit of crocodiles, which conceal themselves among the rushes; rustic cottages; superb buildings; priests performing religious ceremonies in their temples; Egyptian women reclined under a bower on the borders of a canal, with caps or musical instruments in their hands; and, lastly, a magnificent tent, near which a general, followed by several soldiers armed with lances and shields, advances towards a female with a palm branch in her left hand, and, in her right a species of garland, which she holds out to him. It was natural," continues this author, " that the sagacity of antiquaries should be employed in so rich a composition. Father Kircher discovered in it the vicissitudes of fortune, Cardinal Polignac the arrival of Alexander in Egypt, and Father Montfaucon exhibitions of the Nile, of Egypt, and of Ethiopia." Barthelemy himself, however, suggests that it is representative of the arrival of the Emperor Adrian in Upper Egypt.

In England, which was long a Roman province, comparatively few specimens of ancient mosaic have been found, but Roman pavements have been not unfrequently discovered; and Britain, it is said, is the only country wherein the accurate designation of mosaic is preserved in tesselated pavement. Among the finest specimens of ancient mosaic pavement may be noticed that discovered in 1799 in the vicinity of Seville in Spain, at the depth of three feet and a-half below the surface. It is 40 feet long and 30 broad, and bears a representation of the circus games in a parallelogram, in the centre, three sides of which are surrounded by circular compartments, containing portraits of the muses, figures of animals, and other objects.

Mosaic work was originally composed of very large pieces, which were not unfrequently gilded. Specimens of this description are still to be seen in England, especially in Westminster abbey, where the tombs of Edward the confessor and of Henry III. appear to have been decorated in this manner in fanciful figures, some of which are perfect, though the greater part are now destroyed.

*Mosaic work of glass.*—In this work, small pieces of glass, varying in size and colour, are prepared; and, to direct the operator in properly disposing these, an accurate sketch is taken of what is proposed to be represented, and which, by means of chalk, is communicated to the plaster previously laid on the frame. The pieces of glass are then applied, with due regard to the relative colours, and are pressed or levelled with the assistance of a ruler. The manner of doing this kind of mosaic is well described by that excellent author, Keysler, in whose time the small pieces of glass were tinted with different gradations of colours in the manner of the finer worsted used for needle-work. The glass was cast in thin plates, and afterwards cut into pieces of different lengths and breadths. Some of those intended for the composition of distant figures were about half an inch in width; but those used for objects placed near the spectator were formed by pieces not thicker than a common pin, of which two millions were said to be necessary to compose a portrait four feet square. The cement employed was very powerful, and consisted of calcined marble, fine sand, gum tragacanth, the white of eggs, and oil. The pieces of glass were duly arranged in cases placed before the operator, as types are placed before compositors in printing. The copy being finished and polished, had completely the resemblance of a rich picture covered with glass. The works of this description, by which the art has been retrieved in modern times, are chiefly those of Joseph Pine and the Chevalier Lanfranc in St Peter's church at Rome.

*Mosaic work of marble* is thus performed.—The groundwork is usually a large piece of white or black marble, on which an outline of the object to be represented, being first delineated, is correctly wrought with the chisel. The cavities are next filled up with pieces of coloured marble, faithfully adapted to the purpose, and these being cemented the artist then proceeds to mark the colours and shadings, after which the superfluous mastic or cement is rubbed off by means of a piece of soft stone with water and beaten cement, and after the process of polishing is completed, the whole work seems to be one perfect piece. Mosaic, or rather inlaid work, of this kind, is to be seen in the church of the invalids at Paris, and also in the chapel at Versailles; and it is only used in the large scale, as in pavements, or in veneering the walls of churches, or palaces, whereas that of precious stones is merely designed as tables for splendid cabinets, ornaments for altar-pieces, and similar purposes.

*Mosaic work of Gypsum.*—This sort of work has been executed in France in so superior a style as strikingly to resemble precious stones, while, at same time, no appearance of joining was at all apparent. Gypsum, or talc, being calcined, pulverised, and sifted, is formed into continued pieces of artificial marbles, which, when finished, are capable of taking a polish not unlike natural marble. The primary consideration in this work is the fixing on a proper ground; and plaster of Paris being well adapted for this purpose, it requires to be spread on a frame of wood so formed that, when the plaster becomes thoroughly dry, it may easily be withdrawn. The sifted gypsum is now boiled in the best glue, and mixed with the proper colour; and the whole being wrought up to the consistence of plaster, is properly applied to the ground. On this preparation, which is five or six inches thick, and coloured like marble or precious stones, the proposed design is executed. By means of sculptors' instruments cavities are formed in it, which are to be filled with the same substance differently coloured according to the object to be represented. The work is next partially polished, when, in order to perfect it, the workmen go a second time over it, qualifying the colours and shades. When mouldings are required in this work, gouges and similar instruments are made use of.

*Mosaic work of precious stones.*—The ground which supports this rare mosaic work is commonly of free stone, and the cement employed is a kind of stucco or mastic; likewise the tools adapted for the purpose are similar to those used by lapidaries and lithographic engravers. The most valuable marbles only being adapted for this department, they are, for the sake of economy, sawn into remarkably thin leaves. To effect this, the block of marble is secured in a convenient position on a bench, and it is cautiously operated on by means of a saw or bow formed of fine brass-wire bent on a piece of wood, together with emery steeped in water. The leaves thus formed are applied to the proposed ground by means of plyers, care being taken that they fit in the most perfect manner.

*Mosaic work of the feathers of birds,* as made by the ancient Mexicans, is well worthy of notice on account of the admirably delicate and beautiful manner in which it was executed. For this purpose, the feathers of particular birds, remarkable for their splendid plumage, were very highly prized. At the undertaking of every mosaic work of this kind, a number of artists convened together; when, having agreed upon a design, and taken their measures and proportions, each artist charged himself with the execution of a certain part of the image, and exerted himself in it, with singular application and patience. Each artist having accomplished his particular task, the different individuals all assembled again, in order to form the entire image from the different portions; and when found perfect, the feathers, by means of pincers, were laid on the cloth and pasted with certain glutinous matter; after which all the parts were united upon a table or a plate of copper, where they were carefully smoothed till the surface of the image assumed the appearance of having been designed with the pencil. These works of feathers were even estimated more than gold by the Mexicans,—and indeed whoever beheld them appeared at a loss whether to praise most the life and beauty of the natural colours, or the dexterity of the artist and the ingenious disposition of art. Many specimens of this sort of mosaic work are said to be preserved in Mexico, but very few of them belong to the period prior to the conquest. Besides all these kinds, the curious art of mosaic work made with broken shells is still in use in Guatimala.

MOSAIC LAW, the most ancient system of laws in the world, and which were delivered by Moses to the Jews. They were of three kinds, moral, ceremonial, and judicial. Besides those which were dictated to him by God, and commonly named the Decalogue, he instituted ceremonial laws for the regulation of public worship, and likewise laws of a political nature for civil government. The first was delivered openly on the top of mount Sinai, being universally obligatory; the second was private and concerned ceremonial rites only; and the last was less private, and therefore to be observed or not, as might suit the nature of any particular government. The Pentateuch, or five books of Moses, called by way of emphasis the Law was so sacred to the Jews that they were scrupulously careful lest it should be polluted by touching the dead, and would, therefore, on no account, permit it to be placed on the bed of any sick person.

MOSAMBIQUE, a territory situated on the coast of Caffraria, in south latitude 14° 58′, and east longitude 40° 44′. Besides the island of Mosambique, which is three miles long and half a mile broad, those of St James and St George, to the eastward of it are under the same government. The principal town of this country is very strongly fortified, has a remarkably convenient harbour, and contains a number of monasteries and churches, as well as many other handsome buildings. The fort which defends this place belongs to the Portuguese, who have attached to it a well stored magazine, and a commodious hospital for sick sailors. Mongala is likewise a town of some importance, garrisoned by the Portuguese, whose chief depot it is for European goods. In sailing to and from the East Indies, the Portuguese shipping usually touch at this island in order to procure refreshments.

The climate of Mosambique is rather hot, but the soil, though generally sandy, yields most of the fruits common to tropical countries. A great abundance of rice, millet, pulse, and roots of various kinds is produced, and the extensive pastures are covered with an immense number of cattle, especially sheep. The wild animals of this country are various; and elephants, stags, and wild boars are very numerous. Mosambique is not without rich supplies of gold, which is washed down by the rivers, and which, together with ebony, ivory, copper, wax, cattle, asses, and slaves, constitutes a lucrative article of commerce. It carries on a considerable trade with the Portuguese colonies in India, from whence it imports tea, cotton, coarse cloth, silk handkerchiefs, tobacco, salt, shells, and beads. The trade is generally free, there being only a fixed duty on slaves, but almost no other Europeans besides the Portuguese are permitted to enter the ports. Notwithstanding all its natural advantages, this kingdom has much declined of late years, by means of the impolitic tendency of the government, the incursions of French privateers, and also of the pirates from the opposite island of Madagascar. The Portuguese first occupied it in 1497, and the colony formed by them was at a former period in a most flourishing condition.

MOSCOW or MOSKOV, a government of the empire of Russia, so called from the river Moscova or Moskva, on which the capital is situated, is bounded on the south by Rezan and Kalugo, from which it is separated by the Occa, on the north by the government of Tver, on the east by the principality of Cachine, and on the west by Rzeva, Bicla, and Smolensko; and it extends in length about 200, and in breadth about 100 miles. The climate, though cold, is not insalubrious, and the soil is tolerably productive, being watered by several rivers, the chief of which, besides the Moskva, are the Occa and Clesma, which empty themselves into the Wolga. The Dnieper, anciently called *Boristhenes,* takes its rise in a vast forest in the western part of Moscow. Situated in the midst of the best provinces of Russia, this country has been the residence of the czars of the empire; from this, in early times, they derived their title of dukes of Muscovy.

Moscow, the capital of the government of the same name, and, prior to the commencement of the eighteenth century, the metropolis of the Russian empire, stands in an extensive plain on the banks of the Muscova, and is perhaps the largest of all the cities of Europe. In describing it, however, we of course chiefly allude to what it was before the dreadful conflagration in 1812.

This city is twenty-six miles in circumference, and consists of five divisions or towns. The central and most elevated part, called the Kremlin, is about two miles in circuit, and bounded by high walls of stone and brick. Most of the houses it contains are constructed of stone, and the principal public edifices are, the ancient palace of the czars, the patriarchal palace, a number of churches, and new convents. Much superior in point of size to the Kremlin, is the division called Khitaigorod, or Chinese Town, in which are numerous public buildings, especially the university founded by the Empress Elizabeth, and the printing-house; and in which also there are a great many tradesmen's shops. The next division, Bielgorod, or White Town, so called from a white wall which formerly enclosed it, extends round the Kremlin and Khitaigorod; and this again is environed by another, named Semlainogorod, from a circular rampart of earth by which it is encompassed. These two latter divisions present to the view a singular contrast of palaces, churches, convents, brick and wooden houses, and wretched hovels. Lastly, the Sloboda or suburbs, which are invested by a rampart and ditch, form an immense circle around the four departments now mentioned, and exhibit a considerable variety of buildings, and of diversified scenery. Flowing through these suburbs in a sinuous direction, the Moskva is augmented by the rivulets Yousa and Neghua, the former of which it receives in the Semlainogorod, and the latter on the west side of the Kremlin; but, excepting in spring, this river is only navigable for rafts.

The extent, irregularity, and strangely varied aspect of this city render it peculiarly remarkable; and it may not unaptly be said to have been founded upon the Asiatic model, and afterwards to have gradually assumed somewhat of a European character. In some quarters, it presents the appearance of a desert place or a paltry village; in others, of a populous town or thriving capital. Some of the streets are paved, others, especially in the Sloboda, are laid with trunks of trees, or boarded with planks, and all of them are of great length and breadth. Numerous places of divine worship are observable in different directions, all built in a singular style of architecture, and many of them roofed with wood, while some are decorated with domes of copper, others of tin painted green or gilt. The houses formed of wood are generally painted, and some of them have doors and roofs of iron; likewise brick edifices having wooden coverings are very common.

The city of Moscow contains above 1000 places of worship; and the bells attached to some of them are of enormous size. (See Bell.) The interior of some of the public churches is very splendidly decorated with rich utensils of silver, and with pictures, and images of saints ornamented with gold. At a former period, it was customary to inter the remains of the Russian monarchs in the cathedral church of St Michael; and here, instead of vaults for the dead, raised sepulchres are employed, which are constructed chiefly of brick in the shape of a coffin; and having each at the lower extremity a silver plate bearing the name of the sovereign and the date of his demise. Of the cathedrals in Moscow, the most superb is that of the Assumption of the Virgin Mary, wherein the coronation of the kings of Russia has usually taken place. Nearly in the middle of the Kremlin stands the church of St Ivan, remarkable as the loftiest building in the city, and which has a circular tower, surmounted by a richly gilt cupola of a conical shape, about 300 feet in height. Among the other public edifices, the foundling hospital, endowed by Catharine II. is worthy of notice. It is a vast quadrangular edifice, capable of accommodating 8000 children, who are well educated, and trained to different branches of industry. The palace of Petrovsky, situated about two miles north from the city, is a spacious brick edifice, constructed, however, in an indifferent style of architecture. It forms the royal residence when the sovereign of the empire visits Moscow.

Besides forming the centre of the inland commerce of the Russian empire, Moscow connects the intercourse between Europe and Siberia. Most of the retail business, however, is confined to the Khitaigorod division, in which, as has been already hinted, the shops are very numerous in one quarter. The navigation is formed by the river Moskva, and by a canal which flows to the Don.

This devoted city underwent a melancholy reverse of fortune in the year 1812, when, with the view of effectually preventing the occupation of it by Napoleon's army, it was subjected to a most dreadful conflagration, the ravages of which continued for several days, till it was wholly reduced to ashes save the Kremlin, a very small proportion of the houses, and a few churches. Subsequently to the miserable retreat of the French army, the renovation of Moscow was commenced; and, in the course of four years, it regained much of its former splendour and population. The emperor visited this city in 1816, when, by his direction, a pyramid was formed of 160 pieces of cannon, which the French troops had there left behind them; and in the following year he, for a time, held his court in the palace of the Kremlin. The population of Moscow in 1818 had increased to 312,000, including the military, which consisted of 21,000.

MOSES, the law-giver of the ancient Jews, son of Amram, and great grandson of Levi, was born in Egypt in the year before Christ 1571; and is acknowleged by Jews and Christians of every denomination to be the inspired author of the Pentateuch, which, in its present form, Dr Geddes conceives, probably first appeared in the time of King Solomon, having been then compiled from the journal of Moses, and other ancient records. From the circumstance of Moses in his narrative uniformly speaking of himself in the third person, some have entertained doubts as to his being the real author. This mode of writing was, however, adopted in ancient times by others besides him, namely, Zenophon, Cæsar, and Josephus; and the veracity of Moses as a writer has been confirmed by Diodorus, Herodotus, and other ancient authors.

MOSHEIM, John Laurence, a German divine and historian of considerable eminence, was born of a noble family in 1695. In early life he devoted his talents to the interests of religion, and he soon attained to high literary honours. He had a royal invitation to settle at Copenhagen, but at the solicitation of the Duke of Brunswick rather preferred fixing his residence at Helmstadt, where, having distinguished himself as a teacher of divinity in the university, he was raised to the dignified office of ecclesiastical counsellor to the court. The different seminaries of education in the duchy of Wolfenbuttle, as well as those in the principality of Blackenburgh, were under the cognisance of Mosheim; and at a period when the university of Gottingen was filled with none but the most eminent professors, he added no small lustre to that celebrated institution in the capacity of chancellor. This remarkable scholar and most excellent man died at Gottingen in 1755 in the 60th year of his age. He was the author of various works, the most important of which is his Ecclesiastical History from the birth of Christ to the beginning of the eighteenth century, written in Latin. An English edition of this work, with notes and chronological tables, by Archibald Maclaine, D. D. appeared in 1758, in five vols. 8vo.

MOSQUE, a Mahometan temple constructed of stone, in a square form, and having before the principal gate a square court paved with white marble, and adorned with marble pillars, which support the roof. This court is furnished with galleries, wherein the Turks perform the ceremony of ablution preparatory to their entering the mosque, the pavements of which are covered with pieces of stuff sewed together, and of sufficient width to admit of a row of men sitting, kneeling, or prostrate. It is unlawful to enter the mosque with shoes and stockings on; and women, being denied entrance altogether, usually remain in the outer porches. The mosque is lighted by means of a considerable number of lamps, and a curious show is occasioned by means of ostriches' eggs, crystal rings, and other objects depending between the lamps. To the mosque belong six elevated towers called minarets, each having three small open galleries highly ornamented and raised above one another, and from whence certain officers regularly call the people to prayers. A kind of hospital, wherein strangers of every religious persuasion are freely entertained for three days, forms an appendage to the generality of mosques. Every mosque has likewise attached to it a *tarbe* or burial-place, containing a tomb covered with green velvet or satin, as well as two tapers, and several seats for the convenience of the persons whose duty it is to pray for the souls of the dead.

MOTE, in law books, denotes a court or convention, as ward-mote or burgh-mote. The term has been also employed to signify a standing water for keeping fish in, or a large ditch surrounding a mansion-house or castle.

MOTION, from the Latin *motio*, has been defined a change of place. The laws of motion are already treated of under Mechanics, *Animal and Muscular Motion* under Anatomy, and *Vegetable Motion* under Botany.

MOTTO, in heraldry a short sentence or phrase written in a scroll, sometimes over, though generally under the arms. See Heraldry.

MOVEABLE generally denotes any thing capable of motion. The term applies to certain festivals of the church, because, though held on the same day of the week, they do not always recur on the same day of the year or month. Easter, for example, is held on the Sunday which falls upon, or next after the first full moon following the 21st of March, and by it all the other moveable feasts are governed.

MOVEMENT, a term sometimes applied synonimously with automaton in mechanics, signifies also among watchmakers the inner work of a clock, watch, or other engine. See Automaton and Horology.

MOULD, or Mold, a necessary implement in the mechanic arts, such as sculpture or foundery, for giving the form or impression to the melted metal as it comes out of the furnace, and is used in gold mines for ingots, in silver mines for bars, in copper or lead mines for pigs or salmons, in tin mines for pigs and ingots, in iron mines for sows, chaldrons, pots, and many other utensils. They are also used by gold-beaters, masons, carpenters, ship-builders, founders, type-makers, coiners, and other artificers. Mould also denotes a loose kind of earth or loam; for an account of which, see *Soils* under Agriculture.

MOULDINGS, in architecture, are certain projectures, the assemblage of which above the surface of a wall, column, or wainscoat, form various decorations, such as cornices or door-cases.

MOULINS, the capital of the department of the Allier in France, seated on the river which gives name to the department, consists of the old and new town, besides two suburbs, and is regularly built, and nearly encompassed by a fine promenade adorned with poplars. It contains a population of about 14,000, and has considerable manufactories of cutlery.

MOUNTAINS. See Geography and Geology.

MOURNING. See Funeral.

MOURZOUK, the capital of the province of Fezzan, in the interior of Northern Africa. See Fezzan.

MOUSUL, or Mosul, a large and fortified city of the province of Diarbeck, in Asiatic Turkey, is seated on the west bank of the Tigris, and supposed by some to occupy part of the site of the ancient Nineveh. It contains a number of mosques, and though said to be in a very dilapidated condition, it is a place of considerable trade, being a thoroughfare from Persia to Syria. The inhabitants, amounting to about 44,000, are chiefly Mahometans, and muslin constitutes the principal manufacture. This place sustained a siege by the Persians in 1743; and in 1758 both the city and surrounding country were visited by a most distressing famine. The elevated tracts in the neighbourhood are said to abound with silver and lead, but the mines are almost totally neglected.

MOZART, John Chrysostom Wolfgang Theophilus, a very remarkable composer, was a native of Bavaria, and born at Salzburg in 1756. Having from his earliest years evinced peculiar talents for music, he improved with amazing facility under the fostering care of his father, who was organist of the prince's chapel. Such indeed was the fertility of his genius, that when only in his fifth year he attempted notation, which could scarcely be decyphered, and was capable of performing in public and before princes with great eclat. After exciting the greatest admiration in different parts of Germany by his performances, he exhibited together with his father and sister in Paris, where in 1764 an engraving of him was published, describing him *composer and master of music, aged seven years.* From Paris he was taken to London, and in that metropolis it was proven that in reality he then understood music as a science. His reception in Italy was equally gratifying, and at Bologna he was admitted a member of the Philharmonic society, and also honoured by the Pope with an order of knighthood. In his fifteenth year he composed his first opera, *Mithridates*; and he was subsequently employed, during his travels through Italy and Germany, in preparing occasional pieces for distinguished personages. In 1779 he established himself at Vienna, where he is said to have availed himself of the instructions of the great Haydn; and his reputation was afterwards much increased by the successive pieces he composed, especially the opera of *Idomenes*, which is remarkable alike for science and tender feeling. This, together with another opera, *Don Juan*, called more generally Don Giovanni, he himself esteemed the most valuable of his works. With the Emperor Joseph II. Mozart was in high favour; and though he experienced very little bounty from that prince, such was his attachment to him, that he was even induced to refuse the offer of lucrative employment from Frederick of Prussia. The *Magic Flute* being brought forward in 1792, was rapturously received at Vienna, and procured for him a remuneration of fifty guineas. But the tranquillity of Mozart was, in consequence of his extraordinary success, not a little disturbed by the machinations of narrow-minded rivals; and this, together with his excessive application to study, ultimately tended to render him the hapless victim of despondency. So fertile and indefatigable was he in composition, that he has been known to produce a perfect opera within less than twenty days. His ardour of mind was, however, far beyond his bodily strength, and he died in 1792 at the early age of thirty-five years. The attainments of Mozart extended to every department of the science, and he had the extraordinary merit of substituting energy, variety, and expression, for the langour and monotony of previous composers, so that he has been very justly pronounced the greatest composer of his time. It is also worthy of remark, that while he was not insensible of his own great powers, his liberality in appreciating the works of others was quite exemplary. Thus, to a busy critic, who attempted to discover certain defects of the inimitable Haydn, he once said, "Believe me, Sir, were you and I amalgamated together, we should not afford materials for one Haydn."

In 1781 Mozart married Constantia Weber, by whom he had a son and daughter, and after his decease his family was generously supported by the inhabitants of Vienna. His son, who followed the musical profession, is said to have composed many operas for the piano-forte.

MUFFLE, an earthen vessel, arched above and flat below, representing an oblong vault open at one end, and perforated in the sides with small holes. In assaying and enamelling, this utensil is placed horizontally in the furnace, where it is generally secured by luting, and under it are placed small crucibles, so that the substances contained in them are thus heated without contact of fuel, smoke, or ashes. In assaying, when the metal has become red hot, the alloy is beat out to a thin plate rolled up into a sheet of lead, obtained from the reduction of litharge, and put into the cupel. See Metallurgy.

MUFTI, the chief dignitary in the Mahometan religion. He is elected solely by the Grand Signior, on which occasion a rich vestment of sables is presented to him; and so great in his authority, that even the sultan himself must consult him before he inflict punishment of any kind. To him alone belongs the privilege of kissing the left shoulder of the sultan, while the prime vizier kisses only the hem of his garment. The titles of dignity with which the Mufti is usually addressed in writing are florid in the extreme, he being styled the wisest of the wise, the most excellent of excellents, and the key of the treasures of truth. But in case any flagrant crime, more especially treason, be committed by him, a mortar is preserved in one of the Seven Towers at Constantinople for the purpose of pounding him to death.

MUGGLETONIANS, a sect so called from their leader Lodowick Muggleton, a tailor, who maintained that he and his associate of the name of Reeves, being the two last witnesses of God that should appear, were therefore inspired with prophesy, and invested with the power of election and of saving or damning whom they pleased.

MULBERRY TREE, *Morus*, a genus of the Monœsia class of plants. See Botany and Gardening.

MULL, one of the western islands of Scotland. See Hebrides.

MULLER, a stone with a smooth flat bottom, employed for grinding substances on a marble. This instrument is used by apothecaries for preparing their testaceous powders, and by painters for grinding their different colours. The same term is applicable to a similar instrument made use of by glass-grinders and consisting of a piece of wood turned round, and of six inches in length, to one end of which the glass to be ground is cemented. See *Grinding*, under Glass Manufacture.

MUM is the name given to a kind of malt liquor which forms a common beverage in Germany, and is chiefly made in Brunswick. It is brewed in the following manner, as is recorded in the town-house of that city: Take 63 gallons of water that has been boiled till one-third part is consumed, and brew it with seven bushels of wheaten malt, one bushel of oat-meal, and one bushel of ground beans. When it is tunned, the hogshead must not be filled too full at first: As soon as it begins to work, put into it 3 lbs. of the inner rind of fir, 1 lb. of the tops of fir and beech, three handfuls of carduus benedictus, a handful or two of the flower of rosa solis; add burnet, betony, marjoram, avens, pennyroyal, and wild thyme, of each a handful and a half; of elder flowers, two handfuls or more; seeds of cardamum bruised, 30 oz.; berberries bruised, 1 oz.

When the liquor has worked a while, put the herbs and seeds into the vessel; and after they are added, let it work over as little as possible; then fill it up: lastly, when it is stopped, put in the hogshead ten new laid eggs unbroken; stop it up close, and it will be fit for use at the end of two years. Instead of the inner rind of fir, the English brewers employ cardamum, ginger, and sassafras, and likewise add elecampane, madder, and red sanders.

MUMMY, a body preserved by being dried or embalmed. For the methods of embalming practised by the ancient Egyptians, see Catacomb and Egypt. Besides the mummies found in the catacombs near Cairo, bodies which are free from putrifaction have frequently been discovered in the Lybian sands. Natural mummies have likewise been found in the vast caverns of Poland. They are of a blackish colour, being dried with the flesh and skin, which are shrunk up close to the bones.

MUNDEN. See Minden.

MUNICH, the capital of Bavaria, seated on the Iser, and adorned with a superb palace and numerous public edifices, is enriched by an academy of Sciences, as well as by other literary establishments, and contains a population of about 48,000. Besides a considerable trade in grain, salt, wood, and iron, it carries on various manufactures, among which are silk, tapestry, velvet, and woollen stuffs, playing cards, and piano-fortes. The town is regularly built with broad streets, and has a delightful market place. The Imperial hall is 118 feet long and 52 broad, and contains a cabinet of 130 miniatures, each of them valued at 200 old Louis; also a large collection of diamonds, rubies, and emeralds, with a fine organ, and a superb picture of Michael Angelo. Munich is one of the finest and most populous cities in Germany. In the vicinity are three royal residences, Nymphenberg, Sclosheim, and Furstenried. This city has been frequently taken in the wars of Germany, and was attacked by the French in 1796, and also in 1800.

MUNICIPAL, in the Roman civil law, is applicable to persons invested with the rights of citizenship. The municipal cities were only inhabited by persons qualified to enjoy civil appointments in Rome, but they notwithstanding possessed fewer privileges than the colonies, as they were without suffrages or votes, and merely governed by their own laws and magistrates To a few of these cities, however, appertained the privilege of votes. The term municipal, with us, applies to such laws as regulate the affairs of a city or province; and mayors, sheriffs, or consuls, who are elected to maintain the rights and privileges of cities, as well as to preserve due order among the people, are denominated municipal officers.

MUNITION, signifies the provisions for the support of a beleagured place, or for that of a camp or a fleet. During an engagement, munition ships, having stores on board, take their station in the rear, and merely attend to what orders are sent to them by the admiral.

MUNSTER, the largest and most southerly of the four provinces into which Ireland is divided, is bounded by Connaught and Leinster on the north, and by the ocean on the east, west, and south. It includes an area of about 9276 square miles, contains six counties, namely Clare, Tipperary, Limerick, Kerry, Cork, and Waterford, and is subdivided into 59 baronies and 816 parishes. See Ireland.

MUNSTER, a principality of Germany in the late circle of Westphalia, is bounded on the north by East Friesland and Oldenburg, on the east by Osnaburg, on the south by the duchies of Westphalia and Cleve, and on the west by the Netherlands. It contains an area of about 1360 square miles, and is watered by the Ems, Vecht, Lippe, Berkel, and other rivers, all of which yield abundance of fish. The country does not present any mountainous elevations, but is agreeably diversified with occasional heights, fertile plains, fine woods, and extensive heaths. The bishopric of this principality was secularised, and received, in 1802, as an indemnity by the king of Prussia.

*Munster*, the capital of the principality of the same name, now attached to Prussia, is a tolerably well built town, situated on the banks of the river Aa, and has its ramparts flanked with trees, forming a delightful promenade. The principal buildings consist of the churches, which are eleven in number, and the Episcopal palace, besides some antiquities. One of the churches, St Lambert's, is remarkable for three iron cages at the top of the tower, in which John of Leyden, king of the Anabaptists, who possessed himself of the city in 1535, was suspended, together with two of his chief associates. Munster contains 13,000 inhabitants, but was at a former period much more populous. It has three schools for the education of youth, and carries on some trade in grain, wine, and coarse linen.

MURAL-CROWN, among the Romans, was a crown in the form of a circle of gold, indented and embattled, and was conferred as a mark of merit on the person who first mounted the wall of a beleagured place and there lodged a standard.

MURAL-ARCH, a wall, or walled-arch, situated upon the meridian line, and whereon is fixed a quadrant, or other astronomical instrument, for observing the meridian altitudes of the heavenly bodies.—It was first adopted by Tycho Brahe.

MURCIA, a province in Spain, situated on the shores of the Mediterranean, is about 30 leagues in length and 20 in breadth, and very mountainous. It enjoys a salubrious climate, except in summer, when the heat is very great; and the soil, though dry, is remarkably fertile, especially along the banks of the Segura, which is the chief river. Besides the produce of fruits, the country yields rice, pulse, wheat, sugar, hemp, olives, and saffron. But the grand commodity of Murcia is silk, for procuring which the white mulberry is most extensively cultivated. The mountains appear to be rich in mineral productions, and are covered with odoriferous plants and shrubs. In several parts there are hot springs, which, being beneficial in rheumatic and paralytic cases, are much celebrated. Murcia is but thinly inhabited, though some villages in it are sufficiently populous. The natives are characterised as dull and indolent in the extreme; consequently the arts and sciences are neglected amongst them, and even a tolerable workman is rarely to be met with. Owing to the badness of the roads, likewise, the inland trade is very circumscribed. Some commercial intercourse is, however, carried on chiefly by foreigners; and in return for the exports of silk, wine, worked spart, grain, saffron, cutlery, and ribbons, the province receives beef and mutton, fruits, spiceries, linen and silk stuffs, hardware, and an accession of wealth, the balance of trade being in favour of the exports. The beasts of burden in this province are asses, mules, and oxen, and the vehicles employed in travelling are coaches, calashes, and volantes. In 1788 the population was estimated at 338,000.

*Murcia*, the capital, and formerly a fortified city, stands in a pleasant valley near the Segura, but is indifferently constructed, and the churches are the only public edifices, of which the cathedral in particular, though awkwardly designed, is worthy of notice on account of its rich ornaments and paintings. The botanic garden and different promenades are the chief places of recreation. This city is the see of a bishop, whose diocese includes nearly the whole province, the revenue of which is estimated at L.22,916 14s. 4d. It is divided into eleven parishes, and, including the inhabitants of the neighbouring plain, contains a population of about 60,000. In the gardens of Murcia are produced the best fruits in Spain. Among the manufactures of this place are saltpetre, gunpowder, porcelain, spart, silk-stuffs, and ribbons. The citizens are generally uninformed, of a gloomy and choleric disposition, and also unhealthy, owing to their habits of indolence and the want of proper support.

*Carthagena*, a sea-port town, with an excellent harbour, and considerable docks and magazines, is seated on the gulph of the same name, and at the distance of 27 miles south from Murcia. It contains a few institutions for the education of pupils for the royal navy, and is a great mart for merchandise, especially wool. Barilla is plentifully produced in the neighbourhood, and also a red earth named *almagra*, which is employed in preparing snuff and for polishing mirrors. It is worthy of remark, that this is the only town in the province wherein the inhabitants evince any activity, affability, or enjoyment; but, indeed, Carthagena is chiefly occupied by foreigners, collected together for the purposes of trade.

The other towns deserving of notice are, Lorca, Jumilla, Albacete, and Almanza. See Laborde's *View of Spain*.

MURDER denotes the unlawful taking away of a person's life. See HOMICIDE.

MURRAIN, an infectious disorder incident to cattle, and of which the symptoms are heaviness and swelling of the head, shortness of breath, rattling in the throat, and giddiness. It is induced chiefly by a hot dry season, or a general corruption of the air, and proves fatal if not timeously checked. About the middle of the last century, when this malady raged violently in different parts of the continent, the cure made use of was an equal mixture of gunpowder, soot, salt, and brimstone, one spoonful of which formed a dose, and was washed down with warm water. To prevent murrain, it is recommended that cattle should stand cool in summer, and have plenty of good water, as well as dry and sweet fodder.—Against the murrain in hogs, a recipe is given in the 36th volume of *Annals of Agriculture*.

MURRAY, ALEXANDER, D. D. professor of Hebrew and Oriental languages in the university of Edinburgh, was born in the stewartry of Kirkcudbright, parish of Minigaff, in 1775. In early life he evinced extraordinary powers of mind; but his almost total want of books, and of the means of obtaining them, together with his remote residence from the parochial school, greatly obstructed the first efforts of his genius, and nearly precluded him from every advantage of education, so that he did not enjoy the benefit of a teacher more than two years till he went to prosecute his studies at the university. Destined, however, to make a distinguished figure in the literary world, his energy of mind was not to be discouraged by surrounding difficulties; for, notwithstanding his scanty means, such was his proficiency at the age of 16, that he wrote an epistle in Greek to the clergyman of his native parish. Having accidentally seen a copy of the Hebrew bible, he in consequence obtained a grammar of that language, and in a very short time was perfectly qualified to translate Hebrew fluently, though he had never heard a word of it pronounced. This wonderful maturity of genius could not fail to procure him friends as well as admirers, and among these was Mr Maitland, the clergyman above alluded to, who not only patronised him himself, but likewise recommended him to the particular notice of Principal Baird of Edinburgh, who encouraged him in his pursuits, and continued to befriend him to the end of life. During the period of his academical studies, Mr Murray was extremely successful as a private teacher, by which means, as well as by correcting the press, he was enabled to support himself genteelly; and he was, besides, employed as editor of the Scotch Magazine—a publication to which he occasionally contributed some of his own poetry and essays. About this time he likewise became a preacher of the gospel, and was soon afterwards ordained minister of Urr, in his native stewartry, in 1806.

Having in his youth attained some knowledge of the Ethiopic alphabet, he continued to prosecute the study of that language, by the help of the Polyglot Bible and of Ludolph's Dictionary, during his residence in Edinburgh. Mr Murray's complete acquaintance with that ancient tongue soon afterwards became conspicuous from the publication of the travels of the celebrated Mr Bruce in Abyssinia, edited by him; in consequence of which a request was made to him by the Secretary of State to translate a letter from the king of Abyssinia to our government; and it seems more than probable, that the accuracy and dispatch with which he executed this commission contributed not a little to his success in afterwards obtaining the professorship of Hebrew and Oriental languages in Edinburgh. On the death of the Rev. Dr Moodie he was appointed to succeed that professor, and accordingly commenced his course of lectures with great eclat, having previously prepared for the use of his class a syllabus, entitled "Outlines of Oriental Philosophy." To the infinite regret of all who appreciated the splendid talents of Dr Murray, his career of usefulness was soon terminated. Naturally of a feeble constitution, and subject to an asthmatical disorder, which was no doubt increased by his habits of unremitting study, his extraordinary exertions suddenly overpowered him, and he died in 1813 at the early age of 37. This eminent scholar was author of the "History of European Languages," which, though a posthumous publication, is deservedly esteemed by the learned for its originality, accuracy, and erudition; and he likewise contributed several articles to the Edinburgh Review. Out of respect to his splendid talents, government, much to their own credit, have been pleased to bestow a comfortable settlement on his son and daughter.

MURRAY, WILLIAM, Earl of Mansfield, fourth son of the Earl of Stormont, and born in 1705, at Perth, received the principles of education at Westminster, and completed his studies at Oxford, where he also obtained his degrees. He afterwards entered at Lincoln's Inn, and ere long became a prominent figure at the bar in the capacity of an advocate. The appointment of Solicitor-general was conferred upon him in 1742, in which year, likewise, he became member of Parliament for Boroughbridge. In 1757 he was raised to the dignity of chancellor of the Exchequer, and about the same time he was created Earl of Mansfield. Having, in consequence of the disturbances in 1780, sustained a serious loss by the destruction of his house in Bloomsbury-square, London, in which his library and papers were devoted to the flames, it was resolved in Parliament that he should be amply compensated, but he magnanimously refused to accept of any remuneration. The infirmities of age induced his lordship to retire from public life in 1788, and on that occasion a most respectful address was transmitted to him by the Hon. Thomas Erskine, in name of the gentlemen of the bar. This eminent lawyer died without issue in 1793, at the advanced age of 89 years, and his remains were deposited in Westminster-abbey. His titles and fortune descended to his nephew the Earl of Stormont.

MUSÆUS, an ancient Greek poet, and one of the first who versified the oracles, is placed in the Arundelian marbles, epoch 15, 1426 B. C. when, it is supposed, his hymns were adopted in the celebration of the Eleusinian mysteries. None of his works are now extant, and all that remained of them in the time of Pausanias was a hymn to Ceres, composed for the Lycomides.

MUSCADINE, a rich wine produced in Provence, Languedoc, and Cividad, and so called, according to some, from the resemblance in taste it bears to the smell of musk, and, according to others, from *muska*, a fly, the grapes being exceedingly relished by flies.

MUSCAT, MASCAT, or MESCHET, the most considerable town, though not the capital, of the province of Oman in Arabia Felix, is a fortified place, with a most excellent harbour, and stands at the foot of a range of mountains on a small bay of the Arabian sea. It has a very hot climate, but is remarkably well supplied with the gifts of nature. Muscat is a sea-port town, and has a very great trade with the different ports of the Red sea and the Malabar coast, as well as with both sides of the Persian gulph and the coast of Caramania. It is, moreover, a mart for slaves from Africa, and carries on a considerable inland trade, not only with the subjects of the province, but likewise with many independent tribes of Arabs. The inhabitants are remarkable for candour and liberality of disposition, being seldom guilty of acts contrary to the established efficacious laws of the country. Such is the nature of the government of Muscat, that even the Imaum, or prince, is liable to be summoned before the Cadi by any aggrieved subject.—Hostilities frequently subsist between the Muscateers and Persians; but what is very remarkable, the ships of the enemy are at all times perfectly free to enter the port of this place, or those of any of its dependencies, for the purchase of goods with ready money. In 1508 Muscat was occupied by the Portuguese, who were expelled about the middle of the 17th century by the Arabs.

MUSCHENBROECK, PETER DE, an eminent mathematician and naturalist, born in 1700 at Utrecht, and died at Leyden in 1751. He first distinguished himself as a learned professor in the university of his native place, and afterwards at Leyden; and he was highly respected as a member of the academy of Sciences at Paris, as well as of other literary institutions. Besides his "Course of Natural and Experimental Philosophy," which has been translated from the original Latin into English, by Colson, in two volumes 8vo. he wrote several other works, all of which evince remarkable penetration.

MUSCOVY GLASS, an appellation given to mica, from the large and thin transparent plates of that mineral substance having been employed in Russia and other northern countries as a substitute for glass. It is still used for windows in the Russian navy, being, on account of its elasticity, not very liable to break on the discharge of cannon. In Sweden, mica is manufactured into various domestic utensils.

MUSES were fabulous deities or goddesses, supposed by the pagans to preside over the arts and sciences, and therefore usually invoked by the poets. According to some ancient writers, they were at first only three in number, namely, *Melete*, *Mneme*, and *Aœde*; but nine are mentioned by Homer, Hesiod, and others. Callimachus likewise gives the attributes of the nine muses in an epigram, which, however, does not perfectly accord with the ideas of other mythologists. It is as follows:

*Calliope* the deeds of heroes sings;
Great *Clio* sweeps to history the strings;
*Euterpe* teaches mimes their silent show;
*Melpomene* presides o'er scenes of woe;
*Terpsichore* the flute's soft power displays,
And *Erato* gives hymns the gods to praise;
*Polymnia's* skill inspires melodious strains;
*Urania* wise, the starry course explains,
And gay *Thalia's* glass points out where folly
reigns.

The muses, called also virgins by some, were originally singers and musicians in the service of Osiris, or the great Egyptian Bacchus; and being afterwards deified, were styled the daughters of Jupiter and Mnemosyne. Many fanciful notions have been recorded by the ancients respecting the muses, whose individual names are allegorical, and who are represented as modest, young, handsome, elegantly attired, and crowned with flowers. Mount Helicon in Bœotia, and Parnassus in Phocis, were sacred to the muses.

MUSEUM, a repository of rare and interesting objects and curiosities in natural history and the arts. The term was originally applied to a part of the royal palace of Alexandria, which was devoted to the muses and the interests of science. Establishments of this description have become numerous in modern times, and among the most remarkable are those of the Vatican, Florence, Paris, Oxford, and London, as well as the Hunterian museum at Glasgow, and that attached to the university of the Scottish metropolis.

The *Ashmolean Museum* at Oxford, founded in 1679, and the first in England, owes its origin to the learned and industrious antiquary Elias Ashmole, whose valuable collection of curiosities, books, and manuscripts are deposited in it. Among the accessions which have been made to this excellent establishment are various Egyptian and Roman antiquities, especially hieroglyphics, an entire mummy, altars, medals, and lamps.

The *British Museum* occupies a very magnificent edifice, formerly the Duke of Montagu's, in London, and was established in 1753 by act of Parliament, in conformity to the will of Sir Hans Sloane, who left his museum to the nation on condition that Parliament provided a house sufficiently adapted for its reception, and also paid to his executors the sum of L.20,000. To this grand collection, which cost Sir Hans Sloane L.50,000, others were, by the munificence of Parliament, united, and the whole museum was completed at an expense of L.85,000, which sum was raised by way of lottery. Being immediately under the care of government, the concerns of this museum are conducted by fifteen trustees, who are among the highest and most honourable officers of the state. This noble institution contains, besides the Slonean museum, the libraries of Sir Robert Cotton and Major Edwards, the Harleian collection of manuscripts, Sir William Hamilton's collection of fictile or Greek vases, Mr Townley's marbles and bas reliefs, the late Marquis of Lansdown's manuscripts, and the Elgin marbles. The whole library of books and manuscripts collected by our kings from Henry VII. to William III. was presented to it by George II. A collection of pamphlets, published between 1640 and 1660, was given by George III. who likewise made many other most valuable and useful contributions. In 1803, many articles of Egyptian antiquities, acquired from the French by the capitulation of Alexandria, were deposited by government. Among the more recent accessions are Greenwood's collection of stuffed birds, Hatchet's minerals, Halhed's oriental manuscripts, Tyssen's collection of Saxon coins, Dr Bentley's classics, the Greville collection of minerals, Dr Birch's library, Gustavus Brander's collection of fossils, the collections of classics conferred by Thomas Tyrwhit and Sir William Musgrave, together with a splendid collection of books, prints, coins, medals, minerals, shells, and gems, bequeathed by the late Reverend M. Cracherode, and many other private donations from various quarters.

The *Hunterian Museum*, belonging to the college of Glasgow, is a most superb collection of natural history, paintings, medals, minerals, anatomical preparations, and books, which is contained in a handsome edifice erected for the purpose. It is peculiarly rich in medals, the original cost of which was L.23,000. For the first and second series of this almost unrivalled assemblage of numismatic rarities the immense sum of L.20,000 Sterling was offered by the trustees of the British museum, who likewise were willing to return all the duplicates, together with casts from the originals of those that were kept. A *General Account of the Hunterian Museum* has been drawn up by Captain J. Laskey.

The *Museum in the University of Edinburgh* is one of the most splendid collections of this description which is to be found in Europe. Its treasures are deposited in a magnificent saloon, with galleries, &c. in the western part of the new college; and from the great zeal and exertions of Professor Jameson and other friends of the university, it is likely ere long to obtain a great accession of valuable contributions. We regret that particular circumstances prevent us from giving a detailed account of its contents and history, as we have found insuperable difficulties in the way of obtaining such information as would have enabled us to make this notice more satisfactory; but these, we trust, will soon be put an end to, along with the practice of exacting money for exhibiting this museum to the scientific or to the curious and liberal students of natural history—a department in which this museum has no rival in Britain.

Of the foreign museums, those of Paris, Vienna, Berlin, Florence, Petersburg, Copenhagen, and Amsterdam are the best; but our limits prevent us from giving any minute account of those interesting establishments.

# MUSIC.

Definition.

Music, one of the fine arts, which attains its end through the medium of sounds. The word is derived from the Greek ΜΟΥΣΑ, *Musa*.

*History.*—There can be no doubt that the art of music had its origin in the earliest ages. Before the invention of letters, barbarous nations were necessarily obliged to entrust the record of their transactions to tradition; and verse and song seem to have been employed by them all as an assistance to the memory. Nor have nations, even in the earliest stages, been found any where among whom dancing to music of some kind has not prevailed.

Of the music of the most ancient nations, the Egyptians, Hebrews, Chaldeans, Phœnicians, Thracians, &c. nothing is known beyond the fact, that they had musical instruments of the wind and stringed kind, as well as pulsatile. And when historians have related a few traditions respecting the names of Hermes Trismegistus, Linus, Orpheus, Amphion, &c. to whom different inventions or improvements are ascribed, they have given all that can be learnt of the earliest ages of music.

Of the music of the Greeks in the more advanced periods of their history, but very little is known. Enough, however, is ascertained concerning their scales, intervals, and rhythm, to satisfy a candid inquirer that their music had little resemblance to that of modern Europe; that it was vocal only, regulated entirely by the rhythm of their poetry; that they had no instrumental music properly so called; that their melodies were hardly capable of being accompanied with harmony, in the modern sense of the word; that their notation was extremely cumbrous and imperfect; in short, that the art, compared with its state in modern times, was but in its infancy.

Whatever was the state of this art in the Roman empire, it shared the fate of all arts and sciences on the irruption of the barbarous nations. Some remains of ancient music were preserved in the church; and it was there that the germs of new inventions first appeared, which, in process of time, grew up and came to maturity.

About the middle of the fourth century, Flavianus, bishop of Antioch, established a regular chorus, which he separated into two parts, singing the Psalms of David alternately. From Antioch this practice soon spread over the whole church. It was called *Antiphonal-singing*. It is mentioned here as the germ of music in fugue and canon.

Towards the end of the same century, Ambrose, bishop of Milan, chose four *modes*, in which he appointed the service of his church to be sung. To these modes he gave the ancient Greek names of Dorian, Phrygian, Æolian, and Myxolydian. The modes of Ambrose, however, were not the same scale of different pitches as the Greek modes were, but the notes of one scale, reckoned successively from D, E, F, and G. To each of these, which were called the authentic modes, Pope Gregory the Great, about the beginning of the seventh century, added its *plagal* mode, that is, its adjunct or collateral mode. The difference between the two was this, that in the authentic modes the chants were confined to the eight notes above the key-note, and in the plagal to the octave reckoned from the fourth below. Hence it is, that in fugues, the subject being first heard in the tonic or authentic, the answer is given in the scale of the fifth of the key, or plagal mode.

History.

The same Gregory banished from the music of the church the rhythm of ancient poetry, and established the plain chant or *canto fermo*, in which the notes are all of equal length; which Rousseau blames severely, as depriving the music of all energy. This, however, afterwards proved of real service, as, by the removal of the ancient rhythm, which, however excellent in poetry, is not the best for music, room was made for that better rhythm, consisting of equal measures, of which modern music is constituted.

This pope also made an important improvement by applying seven letters of the Roman alphabet to the notes of the scale, repeated in different octaves. The Greeks denoted their great system of two octaves by fifteen letters. It is, indeed, very curious that that ingenious people took no advantage of the resemblance of one octave to another to methodise or abridge their notation.

The introduction of the organ, about the year 666, into the service of the church, is an important event in the history of music. There is no doubt that this instrument gave occasion to the invention of music in parts, or harmony in the modern sense. It gave such opportunity of sounding several notes at once as could not fail to cause the good effect of some consonances to be observed. When voices came to be employed in the same way, the word by which this was first denoted, *organicare*, clearly points out the origin of the practice.

The invention of musical notation by writing on the lines and spaces of the staff, as still practised, was another important step. The inventor of this method, or at least the person who brought it to perfection, was Guido, a monk of the order of St Benedict at Arezzo, the ancient Arctium, in Tuscany, hence called Guido Aretinus, who flourished about the beginning of the eleventh century. It appears that, a little before his time, *points* were placed on seven lines, perhaps to represent the strings of the lyre. Guido placed them on both lines and spaces, and thus reduced the number of lines to four, the staff which is still used in the Romish church. A letter placed at the beginning on a line or space determined the name of every other, or furnished the key by which it was interpreted; hence, the clefs, which were originally Gothic letters, disfigured by time to their present shapes.

Guido was also the inventor of the art of singing by six syllables, applied so as to mark the places of the semitones, called *solmisation.* This art was not unknown to the ancient Greeks, who used four syllables to denote the intervals of their tetrachords, *ta, te, the, tho.* It seems surprising that Guido stopped short of Gregory's seven letters, which completed the scale, the other being a repetition of the first. But Guido and his followers for several ages regarded the greater seventh of the scale, so important in modern times, as irregular, and to be avoided as much as possible. He distinguished three hexachords; applying to each the six syllables, *ut, re, mi, fa, sol, la.* The first began on the lowest line of the bass clef, which was denoted by the Greek letter gamma: the second began on C on the second space, and the fourth on F on the fourth line, B being flattened as fourth in the scale; and these three being repeated in the octaves above, carried the scale up to *e* on the fourth space of our staff of five lines. In each hexachord the syllables *mi fa* were applied to the interval of semitone. This method of solmisation by hexachords continued long all over Europe, and is we believe still practised at Naples, where some of the greatest singers have been formed. A seventh syllable *si*, to complete the scale, has since been added; and with this improvement, the method of solmisation is the happiest invention yet devised for learning to sing by note.

From Guido's notation two or more parts to be sung together were called *counterpoint,* the simultaneous sounds being denoted by *points* or *notes* set opposite to each other on the lines or spaces. Traces, however, of harmony, such as it was, are found considerably before Guido's time. The first concords used were octaves, fourths, and fifths, and the first accompaniments to the voice consisted of these intervals in similar motion. The fourth was long the favourite interval; and the accompaniment sometimes consisted entirely of fourths, which was called *diatessaronare.*

Franco of Cologn, about the middle of the eleventh century, recommends the mixture of thirds, major and minor, with fifths and unisons. The sixths he reckons discords, but allows the use of them. The seconds, sevenths, and greater fourth, he says, are intolerable discords.

Marchetto of Padua, who flourished from the latter part of the 13th till the middle of the 14th centuries, is the first who speaks of the resolution of discords, and forbids two sevenths, or fourths used as discords, successively between the same parts. John de Muris, or Meurs, in Normandy, in the 14th century, lays down the same rules for the succession of concords which are obeyed to this day. "It must be remembered," says he, "that no two parts should ascend or descend in perfect concords, though imperfect may be used without limitation."

The art of counterpoint gave occasion to the invention of the time table, one of the most important steps in the progress of the art. "Music," says Dr Burney "before the invention of counterpoint, consisted as far as we are able to discover, in cantofermo, or melodies equally simple; on this inelegant and insipid treble, harmony was grafted and practised in the church; but the discovery which was afterwards made in the invention of characters for time was much more important, as it constitutes the true era of musical independence; for, till then, if melody subsisted, it was entirely subservient to syllabic laws. Music, considered abstractly, without the assistance, or rather the shackles of speech, is now become a rich, expressive, and picturesque language in itself."

The invention of some marks for time, seems to have been made, and to have had some progress between the time of Guido and that of Franco of Cologn. The latter, in his *Musica et Cantus Mensurabilis,* gave it that form which it preserved for several ages. About the end of the fourteenth century, musicians began to abandon Franco's rhythmic feet, and to introduce into the measure as many sounds as the divisions of time furnished them with. Still there was great perplexity in the rules of notation, in order to ascertain the measure. It was not till the beginning of the seventeenth century, that bars drawn across the score, to divide the strain into equal measures, and mark the place of the accent, came into use. This completed the invention of the time table.

*Florid counterpoint,* or figurative descant, as it was called, soon followed the invention of characters for time; and this led to compositions in canon and fugue. Both John Tinctor and Franchinus Gafforio, who flourished in the fifteenth century, ascribe the invention of figurative harmony to the English, and specifically to John Dunstable, who died in 1453 or 1458. This new art, as Tinctor calls it, soon spread over Europe; and it is certain that the first compositions for the church, which were printed and which were composed in the fifteenth century, are full of canons and fugues of the most artificial kind.

Harmony owed its invention and first cultivation to the church; but melody or air must be sought for elsewhere. "The first secular music in parts," says Dr Burney, "that I have been able to discover on the continent, is the harmony that was set to the rustic and street tunes of the kingdom of Naples; and these, under the several denominations of *Arie, Canzonette, Villotte,* and *Villanelle alla Napolitana,* were as much in fashion all over Europe, during the 16th century, as *provincial* songs were in preceding times and *Venetian* ballads have been since. Indeed, with respect to air, which consists in symmetry and grace, it was long unprincipled, and till the establishment of operas no better was perhaps produced than are to be found among the Neapolitan *Villanelle*; for during these times even the key was seldom ascertained, and the number of bars are indeed still more regular by chance and sensibility than by principle."

In the beginning of the 17th century, Jacobo Peri, at Florence, invented what he called *Musica parlanta,* or recitative, which he conceived to be a revival of the species of music to which the ancient dramas were chanted or sung. His opera of Euridice, performed on the occasion of the marriage of Henry IV. of France with Maria de Medici, had great success, and excited the emulation of all the musicians of Italy. Such was the origin of the opera which has gradually brought melody to the highest perfection.

About the same time *instrumental music,* properly so called, began to be cultivated, and was gradually brought to perfection. Ludovico Viadana published general rules for figuring thorough bass, and composed an organ bass different from the voice part. Frescobaldi of Ferrara composed fugues expressly for the organ.

Towards the end of the 17th century the celebrated Arcangelo Corelli, a native of Bologna, settled at Rome. He was the first that shewed the value of the violin, at least the publication of his works established that instrument in the public estimation as of capital importance. A great constellation of eminent composers and performers arose, and carried that class of instruments to the greatest perfection. The cultivation of keyed instruments, the harp and wind instruments, have kept pace with the violin tribe; and instrumental music has reached a height which we can hardly conceive to be surpassed.

## CHAP. I. OF SCALES AND INTERVALS.

1. MUSIC is the art of ordering sounds heard in succession, and their combinations heard simultaneously, in such a manner as to give pleasure to the hearer. Musical sounds continue at the same pitch for an appreciable time, and the successive changes of pitch take place by certain sensible and determined degrees or intervals. These properties, or relations among musical sounds, are happily illustrated by a comparison between singing and speaking. In the latter, the pitch of the voice hardly continues the same for any sensible time; it slides insensibly upwards or downwards; nor do the terminating sounds of these slides necessarily or generally bear a known and determined relation to each other. In singing, on the contrary, the voice holds the same note for a certain time, and then passes to another whose pitch is distinctly different either in acuteness or gravity, and bears a known relation to that just quitted. Public speakers sometimes fall into the fault of holding the note, and of leaping, especially at the conclusion of a sentence, by a musical interval, and this produces what is called *sing-song.*

2. The relations in respect of acuteness or gravity among musical sounds are scientifically described by the proportional lengths of the strings which produce them. But as the knowledge of this matter is not necessary to the understanding of the art, we shall not take up any part of our limited space in its explanation. For practical purposes, the different musical intervals are best described by the degrees of the *diatonic scale* which they severally contain.

3. This scale exhibits a series of sounds in proper relations for the purposes of music. It is denoted by the seven letters, C, D, E, F, G, A, B, and is heard by striking successively the white finger-keys of the piano-forte or organ, beginning with C about the middle of the key-board, and proceeding towards the right hand. If the next finger-key be struck, the sound is found to resemble extremely the first note C; and the two sounds, when struck together, coalesce entirely, insomuch that it is denoted by the same letter C; and being the eighth note in ascending from the first C, is called an *octave* to it; and from thence the scale proceeds in the same order, *d, e, f, g, a, b,* being each octave above the former; and after the same manner the scale proceeds downwards from C by octaves taken below all the sounds.

The other intervals are all, after the same manner, named from their place in the scale, as reckoned from C. Thus the interval from C to D is called a *second*; from C to E a *third;* from C to F a *fourth*; from C to G a *fifth*; from C to A a *sixth*; from C to B a *seventh*; and, lastly, from C to C an octave, as before. These intervals are also denoted by the figures, 2, 3, 4, 5, 6, 7, 8. When two voices or instruments sound the same note together, they are called unisons; and this relation is sometimes denoted by the figure 1.

4. In these reckonings it is to be observed that the note C (or that with which we begin) is always included. Hence every interval contains one step or degree of the diatonic scale less than the name seems to denote. Thus, from C to D is one step or degree of the scale; but D being the second sound in the scale, the interval is called a *second*; from C to E there are two degrees, but the interval C E is a third; from C to F there are three steps, but the interval C F is a fourth, and so of the rest. This method is uniformly followed in musical reckonings.

5. Were all the steps or degrees of the scale equal, it is plain that seconds, thirds, fourths, &c. reckoned from any one of the sounds, would be all of the same nature, as containing the same number of equal degrees. But in the scale, as it is given by keyed instruments, there are two kinds of degrees, the *tone* and the *semitone,* the latter being reckoned half of the former; and from this many important distinctions arise. The two first degrees, C D, D E, are each a tone; but the third step, E F, is a semitone. The three next steps, F G, G A, A B, are all tones; and the last step, B C, is a semitone. There are, therefore, within the octave, five tones and two semitones, the latter being from the third to the fourth and from the seventh to the eighth of the scale. It is of great importance that the student keep this in mind.* This scale is exhibited in musical notation, No. 1. See Plates of MUSIC. The letters T. and S. signify tone and semitone.

6. We have thus two kinds of seconds, distinguished by the epithets *major* and *minor,* the former being the interval of tone and the latter that

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* The above is the account of the degrees of the scale, as they appear on keyed instruments, and as they are generally considered by musicians. But when the intervals to one note, C, are all taken perfectly true, there are found three different kinds of degrees, the steps from D to E, and from G to A, being less than the other tones; and the octave contains three greater tones, two lesser tones, and two semitones. The object of Mr Liston's euharmonic organ is to furnish the intervals of music all perfect; consequently those distinctions subsist in it. The improvement of the harmony is found to be very great.

of semitone. The third, C E, consists of two tones; if we reckon from D, we find that the third to that note is a tone and a semitone, and the effect of the interval is very different from that of the other third, whether the two sounds of each interval be struck in succession or simultaneously. The former is called a major third, and the latter a minor third. By reckoning the degrees, we shall find that, in the scale, there are three major thirds, C E, F A, and G B, and four minor thirds, D F, EG, A C, and B *d*, the last note being in the octave above. The fourth C F consists of two tones and a semitone, and we shall find that there are in all six fourths of the same kind, viz. C F, D G, E A, G C, A *d*. But if we count the fourth F B, we find it to consist of three tones, that is (a tone being reckoned equal to two semitones,) larger by a semitone than the former. Hence F B, and fourths of the same kind, are called *major*, and the other *minor* fourths. The fifth C G, contains three tones and a semitone; and there are six such fifths, viz. C G, D A, E B, F B, G *d*; but the fifth B *f*, contains two tones and two semitones, being thus a semitone smaller than the former, which is *major* fifth, and this latter is *minor* fifth. The sixth C A contains four tones and one semitone, and there are in all four such sixths, C A, D B, F *d*, and G *e*; but the sixth E *c* contains only three tones and two semitones, being thus a semitone less than the other,—hence major and minor sixths. There are three minor sixths, E *c*, A *f*, and B *g*. Lastly, the seventh C B consists of five tones and a semitone; and there is one other of the same description, viz. F *e*; but reckoning the seventh D *c*, we find it to contain four tones and two semitones, that is, one semitone less than the other; the former is major seventh, and the latter minor seventh. There are in all five minor sevenths in the scale, viz. D *c*, E *d*, G *f*, A *g*, B A.

7. The reader will observe, from the statement above, that two notes of the same name give two different intervals, according as the one or the other is the lower of the two. Thus, the interval C D is a second; but D *c*, taking the latter in the octave above, is a seventh. This is called the *inversion* of an interval; and as the two intervals together make up the octave, they are called *complements* to each other, that is, complements of the octave; and it is plain that the greater any interval is, the smaller will its complement, or the interval inverted, be; and *vice versa*. Thus a second inverted, by taking the lower note octave higher, becomes a seventh, and a seventh inverted by taking the higher note octave lower, becomes a second; a third inverted becomes a sixth; and a sixth becomes a third; a fourth by inversion becomes a fifth, and a fifth becomes a fourth. It is further observable, that, in all these cases when the interval is major, the inversion is minor, and the contrary. To make these things plainer to the student, they are set down in the plates in musical notation, which he is supposed to understand, Nos. 2 to 7. He will observe, that these examples are not to be performed in succession as set down, for the effect would be bad, but to be carefully studied till well understood.

8. The scale we have been considering is called the scale of C *major*, the meaning of which epithet will appear by and by; C is called the key-note, and music drawn from this scale is said to be in the key of C major, or in the major mode of C.

If, instead of C, we should begin with G, and keeping still to the white keys of the piano-forte, should strike them successively up to *g* in the octave above, we find the intervals follow the same order till we come to E, the sixth from G; but here the resemblance ceases, and we are sensible that the ascent from E by semitone to F, and thence by a tone to *g*, is not so satisfactory and conclusive as the order in the key of C. Hence the necessity of taking the seventh in the scale of G semitone higher than the fourth of C; which is effected by playing the short black finger-key F♯. Accordingly, music in the key of G major has a ♯ on the line or space where F is written, immediately after the clef, signifying that the note F, wherever it occurs, is sharpened. As the scale of G with F ♯ exactly resembles that of C, it it is plain that if we begin from its fifth above or fourth below D, it will be requisite to sharpen C, the fourth in the scale of G, that it may be the proper seventh in the scale of D, which, therefore, has two sharps after the clef, one on the place of F, and one on that of C. For this reason, exactly, the key of A has three sharps, viz. F♯, E♯, G♯,—that of E, in addition, has D♯,—that of B has A♯ in addition, and so forth. It is plain, that if we reverse this procedure, taking the fifth or fourth below any key-note, with one or more sharps at the clef, it will be requisite to remove the sharp from the seventh of the former scale, that we may have a true fourth in the new one. Thus, if from the key of D, which has F♯ and C♯, we go to that of G, we must remove the sharp from the C; and going from the key of G to that of C, we must remove the sharp from the F. Now, if from C we go to the fifth below, or fourth above F, it is plain that, for the same reasons, the B, seventh in the scale of C, is too sharp for the scale of F; it must be flattened. Hence proceeding by fifths downwards, or fourths upwards, we have a series of keys requiring an additional flat each step. F has B♭, its fifth below B♭ has E♭ in addition,—E♭ has A♭, and so forth. Reversing this process again, there is one flat fewer each step, till we come to C, which has the *natural* scale, that is, with neither sharp nor flat at the clef.

Now it is manifest that all these scales, proceeding exactly in the same order as that of C, each will have exactly the same number of 2ds, 3ds, 4ths, 5ths, 6ths, and 7ths, major and minor, and in the same places of the scale as we have shewn to be in the scale of C; and the diligent student ought to write down, in musical notation, all the major scales, and the intervals belonging to each, till they be familiar to him.

9. The scale, or scales, which we have hitherto considered, are all called major, because the third and the sixth of the scale are both major. There is another scale called the *minor* diatonic scale, which may be found in the piano-forte, by beginning with A, and going up to the octave above, or down to the octave below, keeping still to the white finger-keys. This scale is found to be of a very different character from the major, which character arises chiefly from the mi-

nor third A C, and partly also from the minor sixth A F. It has a more plaintive and wailing effect, though still very agreeable, especially in descending. In the ascending scale, however, the ear, if accustomed to listen to good music, feels a disappointment in coming to the octave of the key-note by a tone instead of a semitone; and this is so imperative, that a satisfactory close cannot be made by ascending to the key-note by a tone. In the key of A minor, therefore, the G is always sharpened in coming to a conclusion. But if in the ascending scale of A the G be made sharp, the step from F to G♯ is very different from the degrees of the diatonic scale. Hence, in order to have a scale ascending throughout by diatonic degrees, the F in ascending is also sharpened. Thus, the minor scale is usually written in two different ways, that is, ascending and descending, as in the example No. 8.

These two scales, namely, the major and minor, furnish two species of music remarkably different in character, which are called the major and minor *Modes*.

10. It is plain that the intervals major and minor in the scale of A, while we keep to the white finger-key, are the very same as in the scale of C, though in very different parts of the scale. But between F (the natural sixth of the scale of A) and G♯, the major seventh, there is an interval very different from those which we have hitherto described; it is called a *redundant* or *superfluous* second, and, by inversion, it becomes a *diminished* seventh. Both these intervals are very much used in modern music. They are set down on musical notation No. 9. By reckoning the intervals in the diminished seventh, the student will find it to consist of three tones and three semitones. Now the major sixth, we formerly observed, consists of four tones and one semitone; so that if two semitones be equal to one tone, the major sixth and diminished seventh are the same interval; and on keyed instruments they are played by the same finger-keys. After the same manner, the redundant second consists of a tone, F G, and a semitone, G G♯. It seems, therefore, by this reckoning, to be the same with the minor third, and, accordingly, on the piano-forte, it is played by the same finger-keys. Yet on instruments capable of perfect intonation, the major sixth and diminished seventh, and their inversions, the minor third and redundant second, differ respectively by a very sensible interval, and produce very different effects. To explain this, we must make the student acquainted with the imperfection of keyed instruments, and with some small intervals which we have not hitherto noticed. And we shall endeavour to do it in such a manner that a person who has an exact ear, and who has been accustomed to tune the piano-forte, may easily satisfy himself of the truth and importance of the doctrine.

11. We have seen that, in seeking a series of scales similar to that of C, to G, D, A, E, B, and F♯, proceeding by fifths upwards, or fourths downwards, we have found it necessary for the major seventh to each key to have F♯, C♯ G♯, D♯, A♯, and E♯; and again, in seeking similar scales in a series of fifths downwards, or fourths upwards, we have found it necessary for the fourth of each respectively to have B♭, E♭, A♭, D♭, G♭, C♭. But, in the piano-forte, there are only twelve finger-keys within the octave, and we are obliged to make one sound serve for two, as in the following pairs united by brackets, $\underbrace{F\sharp\ G\flat},\ \underbrace{C\sharp\ D\flat},\ \underbrace{G\sharp\ A\flat},\ \underbrace{D\sharp\ E\flat},\ \underbrace{A\sharp\ B\flat},\ \underbrace{E\sharp\ F}$; and, for this purpose, the instrument is tuned in such a manner as to divide the octave into twelve equal semitones. Now, this is really a great imperfection in the instrument, because many of the concords are very considerably altered from what they ought to be, in order to satisfy the ear.

To prove and illustrate this, let a square piano-forte, or cabinet one, in which there are only two unisons to each note, be tuned in the present most fashionable way to an equal temperament, as it is called, that is, dividing the octave into twelve equal semitones, in which case the fifths all over the instrument will be equally good, and nearly perfect. Then let one of the unisons of E be stopped, and let the other be gradually a little flattened, the major third, C E, will be found to be gradually and sensibly improved till it become quite perfect. Then, stopping one of the unisons of A, let the other be gradually flattened till it become a true fourth to this new-tuned E; it will at the same time be found to be much more satisfactory as major sixth to C, or minor third below the octave C. Let one of the unisons of G♯ be now stopped, and let the other be gradually flattened till it be quite satisfactory as major third to the new tuned E. It will then be quite right as major seventh or semitone below the new-tuned A.—Lastly, stopping this new-tuned G♯, let the other unison be gradually sharpened; it will be found that the major third below C, the octave, will become more and more perfect. When this major third is quite satisfactory, it will be true as A♭ minor sixth to C, or major third below the octave C. Let these two be now compared, viz. the new-tuned G♯ and the new-tuned A♭, and the difference will be found to be no inconsiderable or insensible interval. It is called the *enharmonic diesis*.

This process explains another distinction, namely, that of *diatonic* and *chromatic* semitone. The G♯ is diatonic semitone below A, which interval is the proper semitone between the major third and fourth, and between the major seventh and octave of the scale. A♭, again, is only chromatic semitone below A, and is plainly a much smaller interval.

12. To return to the minor scale of A. This scale, or music in this mode of A minor, is written without sharp or flat at the clef; the sharp before the sixth or seventh of the key being introduced when the composer chooses, as *accidentals*, which is the general name for sharps or flats introduced in the course of a piece of music. There are thus two *natural* keys, C major and A minor; and these are called *relatives* to each other: A is *relative minor* to the major mode of C, and C is *relative major* to the minor mode of A. It is evident, that to every major mode a relative minor will be, after the same manner, found in the sixth of the scale; and to every minor mode a relative major will be found in the third

Of Melody.

of the scale, and that these relatives will have the same *signature*, that is, the same sharps or flats at the clef; consequently the minor scales will follow the same law with the major, in adding a sharp in every step of the series of ascending fifths or descending fourths, and a flat in every step of the series of descending fifths or ascending fourths. These two series are set down No. 11. where the major keys are exactly over the relative minors. The series of sharps goes on by ascending fifths till we have six sharps at the clef; that is F♯ major and D♯ minor, which, on the piano-forte, are played with the same finger-keys as G♭ major and E♭ minor, which have six flats at the clef. These two, therefore, which, as far as respects keyed instruments are the same, are united by brackets. Hence the series of ascending fifths or descending fourths being continued, one flat is removed at each step, and we come round to C major and A minor, the natural scales.

The student will probably find this account of scales and intervals somewhat dry and uninteresting; but the knowledge of them is quite essential to his making any progress in the science, and a little drudgery at first will soon conquer it, and render subsequent study easy and profitable.

## CHAP. II. OF MELODY.

13. THERE are two great branches of Music, viz. Melody and Harmony. In the ancient language of the science, these two words were synonimous; but in modern music they have distinct and appropriate meanings. Melody is an agreeable succession of musical sounds moving by musical intervals. Harmony is produced by musical sounds, differing by proper intervals, heard simultaneously. Two or more sounds heard simultaneously form a *chord*, and a proper succession of such chords forms harmony. This last, therefore, in some degree implies melody, but it is something more. The union of the two, that is, good melody, accompanied with good harmony, produces the best music. It is necessary, to a certain extent, to consider each branch separately. We begin with melody; and on this part of the subject we shall adopt the doctrine and terms (though without copying the pages) of our respectable cotemporary, the Edinburgh Encyclopedia, edited by Dr Brewster, which appear to us the clearest and most appropriate of any with which we are acquainted.

14. Melody is of two kinds, AIR and RECITATIVE. The characters of air are, 1st, *Rhythm* or *versification*, generally marked by *cadences*; 2dly, *Subject*, that is, the same or similar phrases of melody returning more or less frequently; 3dly, It has a *principal key* or *mode*, from which occasional transitions may be made to other keys, but to which the air returns, and in which it concludes. Recitative is not disposed in verses, it is the *measured prose* of music. It has no principal mode, but changes from key to key frequently and suddenly. It has no subject, though it has melody. It holds an intermediate place between air and speaking, or declamation. From the latter it is distinguished by consisting of *musical* sounds, and proceeding by musical intervals. Hence it is capable of being accompanied by harmony.

Of Melody.

15. Every regular piece of music is divided into equal portions of time called *measures*, which, in musical notation, are shewn by the single bars drawn across the staff. The bar also marks the place of the principal *accent*, that is to say, the beginning of every measure is emphatic, insomuch that the hearer is led to notice the equal measures into which the air is distributed. The same series of notes, barred or accented in two different ways, produces remarkably different effects, which Dr Calcott illustrates by the examples Nos. 12, 13.

16. There are two principal species of measures used in music. In one the measure consists of two or four equal portions, which we call *principal times*; in the other the measure consists of three principal times; the former is called common time, the other triple time. In common time of two principal times, the first is accented and the second unaccented. In that of four times, the first and third are accented, the second and fourth unaccented. "The Germans, and also the French," says Dr Calcott, "consider the measure of four crotchets as a species different not only from that of three, but even from that of two; a distinction which arises from the nature of accent, and which is thought of importance by these authors. It is considered by some of them as a simple measure; but it really seems merely to differ from that of two crotchets by the omission of the alternate bar." In triple time the accent falls on the first principal time; the other two times are unaccented. Two measures of three principal times united form a compound measure, usually, but as we think improperly, called *compound common time*. In this compound time there are two principal accents, one at the beginning and one in the middle of the measure. This measure is usually denoted by the fraction $\frac{6}{8}$, being six quavers or six-eighths of the semibreve. Sometimes, by the omission of a bar, it becomes a measure of twelve quavers, denoted by $\frac{12}{8}$. "The omission of the bars," says Dr Calcott, "makes some difference in the appearance of the music, and influences the counting according to the degree of quickness in which the piece is performed. But in other respects the division of the measure has no power of altering the real nature of the time or tune; nor can the auditor perceive whether the triple time performed be expressed by the figures $\frac{12}{8}$, $\frac{6}{8}$, or $\frac{3}{8}$."

17. The principal times of the measures, whether common or triple, are subdivided in various ways, yet still so as to keep the principal times distinct. The subdivisions are generally by bisection of crotchets into quavers, and these again into semiquavers, which are grouped together according to the principal times. Sometimes the principal crotchet is divided into three, commonly called triplets. Sometimes there is a triplet for each half time, which are generally written in groups of six, called sextuples, and marked by the figure 6 written over the first group. These subdivisions of the measure occasion a kind of inferior accent at the beginning of each group, which, however, as Dr Calcott well observes, do not by any means destroy that great and predominent accent that belongs to the first note which follows the bar.

18. The rhythm of music, however, implies something more than that the composition is divided into equal measures. Several measures are to be grouped together by the phrases of the melody, and by cadences in the harmony, into *verses*, several of which verses united form the air. This doctrine is plainly analogous to the *prosody* of language; we therefore adopt the terms of this last, and define them accordingly as follows:

A *foot* is the quantity of one measure, and contains at least one principal accent. If the air always began on the first note of the measure, the foot and measure would coincide, and there would be no occasion to distinguish them. But as the bars are placed in such a manner as to mark the places of the principal accents, and as the subject very often begins on the unaccented part of the measure, the foot does not always coincide with it, and it is necessary to distinguish them.

Two or more feet constitute a *verse*.

Two or more verses constitute a *strain* or *stanza*.

19. These constituent parts of musical rhythm will be best exemplified, not separately, but united in the air of which they are portions.

The air No. 14. consists of two strains separated by the double bar. Each strain consists of four verses marked (1) (2*) (3) (4*), of two feet each. These verses are all distinctly marked both by the phrases or turns in the melody and by cadences on the harmony. A verse of two feet we call a dimeter.

If the reader attend to his own feelings in listening to this air, he will find that the second and fourth verse of each strain, which are marked with an asterisk, is a more striking and complete portion of the air than the other verses; insomuch that each pair of verses is a kind of whole, and might very properly be called one verse of four feet, or a tetrameter. Each strain, therefore, consists of four dimeters, or of two tetrameters.

This example exhibits feet consisting of simple measures. No. 15. is an air, each strain consisting also of four dimeters, or two tetrameters; and it is plain that the verses (2*) and (4*) bear the same relation to this as the analogous verses in the former. But here each foot consists of double measures, and we have dimeters and tetrameters of a different kind; and this establishes the reality of the distinction between these two kinds of common time measures. These double feet might indeed be made single, by inserting a bar on the middle of each measure. But this would not alter the nature of the rhythm or versification; the dimeters of double feet would then become tetrameters of single feet, just as the Greeks call the same verse an iambic dimeter which the Latins call a quaternary.

20. In these examples the feet in all the verses are complete. But the last foot of a verse is often incomplete, and we have verses analogous to the *catalectics* of the ancients; we will call them *defective* dimeters. The air No. 16. consists of such verses, comprising the time of a simple measure and one-half. In No. 17. defective verses of simple feet, intermixed with complete ones, produce a most happy playful effect. In No. 18. we have defective dimeters of double feet intermixed with simple ones, so as to produce a most pleasing effect, though of a character quite different from the preceding. No. 19. is another happy use of defective dimeters of double feet in triple measures intermixed with complete verses.

21. Musicians frequently use verses of three feet, or *trimeters*, and these in all kinds of measures, common and triple, simple and compound. In triple time we have frequently airs consisting entirely of such verses, as in No. 21.; and two such verses united form *hexameters*, as we have marked on the second couplet. No. 22. is another example, in which, however, the verses are more independent of each other, in other words, are not felt to be so decidedly united in pairs. Were the air No. 16. written in $\frac{3}{8}$ measures, dividing each by a bar, the *defective dimeters* of double feet would become trimeters of simple feet; and, on the other hand, were the measures of Nos. 21. and 22. made compound by removing a bar from each, the verses would be *defective dimeters*.

22. Mr Kollman says that periods (verses) of three measures are not good, except when two of them come one after another, so as to make a compound period of six measures. The example No. 23. shews that this observation is not well founded. The air consists of two dimeters, or one tetrameter, followed by a trimeter, which forms a very agreeable stanza, exactly resembling our English verses of eight and six syllables alternately. In the second half of the stanza, however, the sixth verse, instead of being a trimeter, is lengthened out into a tetrameter, and this is followed by two trimeters.

Variety of versification is one of the chief characters of modern music. National airs have a regularity or uniformity in versification, which, if constantly adhered to, would produce a monotony of effect, or insipidity; and, though the modern masters frequently produce charming airs of the most regular or uniform versification, yet they have often given infinite spirit to their compositions by variety and what some call irregularity of measure. For a more full exemplification of this variety, we refer our readers to our contemporary, the Edinburgh Encyclopedia, though even there the subject is not treated with the fullness which its importance demands.

The effect of rhythm is heightened by cadences in the harmony, that is, by a change of the chord at the end of the verse. The cadence takes place from the unaccented to the accented time of the measure. The student will easily understand this when he has perused the next chapter.

23. The second character of air which we mentioned was *subject*, that is, the same or similar phrases of melody returning more or less frequently. "In every composition," says Zarlino, the most celebrated theorist of the sixteenth century, "many things are requisite; the first is subject, without which there could be no composition." The invention of recitative, since Zarlino's time, has produced an exception to the latter part of the observation; but, to air, subject is of essential importance; it is that which gives it interest and meaning. Without it there may be melody; but a series of phrases, without any common character, however excellent each might be indivi-

dually, would be vague and uninteresting, and, consequently, would soon become tiresome. When an unpractised hearer listens to a new composition, he is at first little interested; he says he does not *understand* it; but when he begins to recognise the phrases, and mark their returns, he becomes sensible of design in their disposition, and says that he now *understands the tune.*

The reader may easily remark these repetitions or imitations of phrase in the examples which we have given of rhythm. Thus the first strain of the air No. 15. consists of two half strains or *distichs* marked (2*) and (4*,) and in each distich the first verse (marked (1) and (3) is exactly the same; and the second verse of each beginning similarly, they are varied in the conclusion. The first distich of the second strain consists of the same phrase varied slightly on the second verse, and the second distich is the same with that of the first strain. In this little air the phrases are clear and congruous, uniting in an easy and flowing manner in one subject, and the whole makes a pleasing and interesting melody.

24. The air No. 20. is in triple time of simple measures; yet the *disposition* of the subject is so similar, that the above observations may be equally applied to the first strain, and with very little change to the second. The reader has but to open a book of Scottish or Irish melodies to find this disposition of the subject exemplified. It is needless to name the airs; the chances are greatly in favour of his finding the first that he touches cast in a similar mould,—and he will find a profitable as well as entertaining exercise in comparing and marking the differences in this respect. But if he extend his enquiries into the compositions of the great masters, he will find the disposition of the subject infinitely varied. It is indeed a matter with regard to which the composer is confined by no rule but that of producing a good effect. There are two opposite errors to be avoided,—monotony, or too great uniformity, which becomes disgusting, and vagueness, by forgetting his subject, which becomes unmeaning and unsatisfactory.

25. Repetition is the same portion of melody in the same part of the scale, or differing by octave brought in in a subsequent part of the air. Imitation is a similar portion of melody in a different part of the scale, and is either perfect or imperfect. Perfect imitation is when the melody moves by intervals exactly the same as those of the portion imitated. Thus, in No. 24. the second straini s a perfect imitation throughout of the first, and, in order to make it so, the flat is removed from A, the fourth of the key, that it may become major seventh in the key of B♭, into which the modulation is carried. Perfect imitation of considerable portions of melody are frequently made without any change of key. Thus, if a portion of melody be confined to the first four notes of the scale, it will be perfectly imitated by writing every note five degrees higher. Imperfect imitation in another part of the scale, where major intervals become minor and minor become major, still keeps up the impression of the subject, while it produces a varied effect. Thus in the air No. 14. the third verse of the first strain is such an imitation of the first. Even a leap in the melody in the same direction, and in a corresponding part of the verse, though by a different interval, keeps up the resemblance. Thus, in the same air, the first verse of the second strain, in the beginning of the phrase, imitates imperfectly the corresponding verse of the first strain, and it concludes by leap downwards of fifth, whereas the other leaps downward by fourth. The second verse of the second strain resembles the corresponding one of the first, though a movement of a third represents one of a second, and a leap of a sixth one of a fifth.

26. The last characteristic of air was, that it has a principal key from which occasional transitions may be made to other keys. Thus the air No. 16, is wholly in the key of C major,—No. 15. wholly in that of A major,—No. 14. if we regard the air only might be wholly in the key of A major, but the harmony makes a slight transition into B minor. In No. 17. there is a formal transition from the principal key of G major, first to D major and then to A minor. But this matter cannot be understood without a knowledge of harmony, and must therefore be reserved to the sequel.

## CHAP. III. OF HARMONY.

27. HARMONY, we have observed, Art 13. is produced by musical sounds differing by proper intervals heard simultaneously; two or more sounds heard simultaneously form a CHORD, and a proper succession of such chords forms harmony. This branch of the musical art is much more susceptible of being taught by rule than that of which we have treated in the preceding chapter; and this matter we are now to explain as fully as our limits will permit.

28. The musical intervals, which we have described in the first chapter, are either *Concords* or *Discords.* Concords are pleasing to the ear in themselves, and they form the essential part of harmony. The discords are less satisfactory in themselves, but a proper mixture of them greatly heightens the effect of the concords.

Unisons, octaves, thirds, major and minor, with their inversions, sixths, minor and major, and the major fifth, are concords.

Seconds, major and minor, with their inversions, sevenths, minor and major, as also the redundant second with its inversion the diminished seventh, and the lesser fifth with its inversion the greater fourth, are discords. The lesser fifth is frequently called the *imperfect fifth,* or the *false fifth;* and these names we shall occasionally use.

It has been much disputed whether the lesser fourth is to be ranked among the concords or discords. In our opinion, this interval is not in itself discordant; it makes part in the most perfect of all chords; whereas a discord properly so called, a second, for instance, or lesser fifth, is felt to be discordant however combined or inverted. Yet the lesser fourth is sometimes felt as a discord, and receives the treatment belonging to that class of intervals.

Thus the dispute in question, like many others, vanishes when terms are properly understood.

29. Concords are divided into *perfect* and *imperfect*. The unison octave and greater fifth are perfect concords; thirds and sixths, major and minor, are imperfect concords. It is necessary that the student recollect this distinction, in order to understand the general rules for the movement of concords.—N. B. The greater fifth is generally called the *perfect fifth*, and the lesser fourth the *perfect fourth*, in contradistinction to the lesser (or imperfect) fifth and greater fourth, which are discords.

30. If along with any sound we take its third and fifth reckoned from it upwards in the diatonic scale, the combination makes a COMMON CHORD; and if we add the octave to the lowest note, the common chord will consist of four parts. Thus if, along with C, the lowest note of that diatonic scale, we take E, G, and *c*, the four sounds struck together make the common chord of C major; and this is called the chord of the key. If we take F, (the fourth in the key of C,) and accompany it with its third and fifth, A and *c*, we shall have a chord of exactly the same kind, that is, consisting of a major third and major or perfect fifth to the bass, to which we may add *f*, the octave to the bass. After the same manner, if, with G, the fifth of the key, we take its third and fifth, we shall have a major common chord: and these three chords take the epithet major from the kind of third; but if we take any other note of the scale with its third and fifth, we have a common chord of a different kind. On the second third and sixth of the scale, we have common chords with minor thirds and perfect fifths, called minor common chords. All these chords, major and minor, are concordant; but if we take the seventh of the scale with its third and fifth, we have a chord of a different kind, the third is minor and the fifth is *imperfect*. It is called the *imperfect* or *dissonant* common chord.

It is plain that the same chords will be found in the scale of A minor, though in different parts of it, viz. the chord of the key, that of the fourth, and that of the fifth of the scale are minor; the chords of the third, of the sixth, and of the seventh of the scale, are major; and the chord of second of the scale is imperfect or dissonant.

The same chords, major and minor, it is plain, will be found in the same parts of the relative scales major and minor, as set down No. 11.

In No. 25. we have set down these chords in the key of C. major.—N. B. Here we must remark, that musicians call thirds, fifths, &c. enlarged by octave, still by the names thirds and fifths. Thus, in the first of these examples, the intervals counted from the bass note are tenth, twelfth, and fifteenth, that is, third and fifth enlarged by octave and double octave: The same holds of the other chords as set down, except of that of B, which consists literally of minor third, lesser fifth, and eighth. Intervals enlarged by octave are by some called compound intervals: but the distinction is not much considered in general. There is, however, one kind of compound interval which musicians expressly distinguish, as we shall see in the sequel, viz. the ninth or octave second.

The chord that belongs to a bass note may be expressed by figures denoting the intervals. Thus the figures 3, 5, and 8, or 3 and 5, or simply the figure 3, denotes the common chord, whether major or minor. In the imperfect chord, a dash is generally drawn through the figure 5 to denote its nature.

31. All the chords in the example 25. are in the same position, that is to say, the third is next the bass, then the fifth, and, lastly, the octave: but the three upper parts may be differently arranged, and produce what are called different positions of the common chord, and these positions are denominated by the highest note. Thus the chords in example 25. are all said to be in the octave position. The bass and highest parts being determined, the two remaining parts may be varied as in example 26.; but the position is still called by the same name. If the third be highest, we may have two forms of what is called the *tierce* position, and so of the fifth or quint position. These two forms of each position make the distinction between *close* and *dispersed* harmony. The same observations apply to the minor chord, No. 27.

32. We may now consider chords in succession. In considering the movement of two parts, musicians distinguish three kinds of motion as related to each other. 1st, If both parts ascend on the scale, or if both descend, they are said to go in similar motion; 2dly, If one part ascend and the other descend, they are said to go in *opposite motion*; 3dly, If one part hold in the same degree while the other ascends or descends, the parts are said to go by *oblique motion*. This being understood, the following are the general rules for the succession of concords.

1. There must not be two *perfect* concords between the same parts by similar motion, as in No. 28. These are technically called consecutive octaves, or consecutive fifths. Octaves are forbidden because they produce no good effect, and fifths because they produce a very bad one.

2. You must not go from an imperfect concord to a perfect by similar motion. Such passages are said to contain hidden fifths or octaves. These hidden octaves and fifths are made to appear by filling in the intermediate notes, as in the Ex. 29.

The first of these rules does not respect the *doubling* of parts in the unison or octave, as is practised continually in symphonies, concertos, and acccompaniments, but the individual parts of a composition properly so called.

These rules apply more strictly to compositions in two parts, and to the *extreme* parts, (that is, the bass and highest part,) than to the inner parts of full harmony.

To the first rule there is one exception universally allowed and practised, viz. a perfect fifth may be followed by octave, the upper part descending one degree, and the bass leaping downwards by fifth, as is frequently seen in a close.

To the second rule there are also exceptions; thus, from a third you may go to a fifth by similar motion, the upper part descending one degree, and the bass leaping in the same direction by a fourth, as in No. 31.; or from a third you may go to the octave, the upper part rising one degree, and the bass leaping upwards by a fourth, as in No. 32.

33. Chords succeed each other best when there is at least one sound common to both. This will be the case when the bass rises or falls by a fifth or by a third. Thus, in the example 33. the bass falls fifth and rises fourth alternately, and we have in succession all the common chords in the key of C major, not excepting the dissonant chord on B. In this example, the rules for the succession of concords are strictly observed. We have between the first and second chord, third and fourth, &c. an octave succeeded by a fifth, but it is in oblique motion, and between the bass and third part a third followed by octave in opposite motion. The chords are alternately in the octave and quint position. In example 34. we have the same progression beginning with the ascent of the bass, and with the tierce position of the chord; and we have the tierce and quint position alternately. Should we put the bass of No. 34. to the chords in the upper parts of 33. we should have a third followed by octave in similar motion between the bass and third part at the beginning of each measure, allowably, the upper part rising a single degree of the scale, as in No. 35. But should we put the bass of No. 33. to the upper parts of 34. we should have a third followed by a fifth between the extreme parts, both parts leaping by similar motion, as shewn No. 36; which is bad, and the more so that it comes on the accented part of the measure. In these examples the parts are all properly connected, and each has a good melody. "To connect intervals properly," says Mr Kollman, "it is required to keep every repetition of a note in its former place, or to change the notes of the different parts in such a manner that the ear may easily follow the progression of each." In example 33. each repeated note is in the same part, and therefore the intervals are connected in the closest manner. In 34. the parts are changed, but still in a clear and melodious manner.

34. Of all these chords, by far the most important is the chord of the key. Almost every regular composition begins and ends with it. It is felt to be the governing chord of the mode, and the others are felt as subordinate to it. It is called the *tonic* chord, from the word by which the French designate the mode or key. The next chord in point of importance is that of the fifth of the key, called the *dominant* chord, or leading chord. These two chords succeed each other very agreeably, whether we go from the tonic to the dominant, or the reverse. The last is always the concluding movement of a piece of music, and is the most satisfactory and complete that takes place among musical progressions, and it is called the PERFECT CADENCE. In this case the third of the dominant always rises to the octave in the tonic chord. The fifth of the dominant may either rise a degree to the third of the tonic, or descend a degree on the octave; the octave of the dominant usually keeps its place, and becomes fifth in the chord of the key, No. 37.

So also, in the minor mode, the most important chord is that of the key or the tonic, and, next to it, the dominant or chord of the fifth of the key. This chord, as it lies naturally in the minor scale, is minor; but it is essential to the character of a dominant that it have a major third. It is the rise of this major third by semitone to the octave that is most productive of the conclusive effect of the perfect cadence. For this reason, both in the major and minor modes, the greater seventh of the scale, which is the major third in the dominant chord, is called the *sensible* note. As this note is not found in the scale of the minor mode, it is produced by an *accidental* sharp to the third of the dominant chord; and this accidental, in figuring the bass, is signified by a ※ written under or over the bass note, as in No. 38.

35. The next chord, in point of importance, to these two, in either mode, is that of the fourth of the key. It is called the *subdominant chord*, and it also alternates very agreeably with the tonic. This chord, however, as its name imports, is chiefly used as introductory to the dominant, as in 39. 40. This makes a very formal and conclusive cadence; but we shall afterwards find some modifications of it of more frequent use. When one common chord succeeds another thus diatonically, that is, the bass moving by one degree of the scale, the upper parts must move in opposite direction to the bass, in order to make up for the want of connection, there being no sound common to both chords, as well as to avoid the consecutive perfect concords which would otherwise be produced. If, for instance, the progression were written as in No. 41. the effect would be quite intolerable, owing to the fifths and octaves in similar motion.

36. Of these three chords, and especially of the tonic and dominant, harmony chiefly consists. But the others are occasionally introduced. The most important after these, in the major mode, is the relative minor, and then the common chord on the second of the key. These five chords are shewn in No. 42. which furnishes an example of the bass falling fifth and rising third, and thus producing connected harmony. No. 43. is another well connected chain of harmony, often used with fine effect, where the bass descends by thirds, alternately minor and major. So also, in the minor mode, the most important chords after the tonic, dominant, and subdominant, are the relative major, (on the third of the key,) and the chord on the sixth of the scale. These chords are exhibited in No. 44. where the bass rises by fifth and falls by third alternately, which also produces well connected harmony. In the second chord the fifth of the key bears a minor chord. Here it has no character of dominant or leading chord. It receives that character at the close by the accidental ※ making its third major.

36. The lowest note of a common chord is called its fundamental bass, and the chord is called a fundamental chord. A common chord has three *real* parts, the octave being only a repetition. Now if, instead of the fundamental bass, we put either of the other two sounds for bass, the whole chord is inverted, and, in consequence, it gets a new name. Thus if, in the chord of C, we substitute for C the fundamental bass E, the third of the original or common chord, we have

by the inversion a chord consisting of minor third and minor sixth, which is called a chord of the sixth, and is figured by a 3 under a 6, or simply by 6, the third being understood. If the fifth of the original chord be made bass, we have a chord consisting of minor or perfect fourth and major sixth, called the chord of fourth and sixth, and figured by a 4 under 6. These are called the first and second derivatives of the common major chord. They are set down in No. 45. If we treat the minor common chord in the same manner, we have, by putting the third in the bass, its first derivative, consisting of a major third and major sixth, figured exactly as the first inversion of the major chord, and called a chord of the sixth; and, by putting the fifth in the bass, a chord consisting of perfect fourth and minor sixth, and figured as in the former case, No. 46. The figuring of chords of so different a nature as the derivatives of the major and minor common chords after the same manner, occasions no confusion to the thorough bass player, because he knows, from the mode in which he is playing, the nature of the intervals denoted. If we treat the dissonant chords on the seventh of the major scale, and second of the minor scale in the same manner, we have for the first inversion a chord consisting of minor third and major sixth, figured simply by 6, or with a ♮ under a 6, representing the third; and for the second derivative a greater fourth and major sixth, figured with a 4+ under a 6, the + added to the 4 signifying that it is the major fourth. These derivatives are both dissonant like the original chord.

A chord of sixth having three real parts has three principal positions, and the harmony may be variously disposed in each, as close or dispersed, or as the third, sixth, or octave are doubled, No. 48. Those positions are best in which the parts are most equally disposed.

37. The chord of sixth on the third of the scale, major or minor, that is, the first inversion of the tonic, alternates very well with the dominant common chord, as in Ex. 49. The first derivative of the dominant, again, *i. e.* the chord of sixth on the sensible note, alternates very agreeably with the tonic common chord, No. 50. As in this case the bass is the sensible note, and, consequently, has a determined movement by semitone to the key note, the bass note ought not to be doubled in the upper parts. The chord of greater sixth, accompanied by minor third, on the second of the scale, major or minor, is dissonant, and both the third and sixth of the chord have that kind of determined motion which is called the resolution of a discord: the interval of greater fourth, between the third and sixth of a chord, is *resolved* by each part moving by one degree of the scale, in opposite directions to a sixth, as pointed out by the strokes in the example No. 51. But this matter will be more fully explained in the sequel. In consequence of these determined movements, neither of these parts ought to be doubled.

38. A common chord is frequently succeeded by a chord of sixth on the same bass; and an ascending series of this kind, as in Ex. 52., is an exceedingly agreeable progression. This example is taken from Mr Shield's Introduction to Harmony. The attentive student will observe, that the imperfect fifth between the bass and highest part in the dissonant common chord on F♮, is resolved on a third by the parts moving towards each other diatonically, as pointed out by the strokes. The intervention of the D, sixth to the bass, before this resolution, does not prevent its effect.

Chords of the sixth are used with much more freedom than common chords, from which they are derived. A diatonic series of common chords upwards or downwards, the parts going in similar motion, would be quite intolerable; yet such a series of chords of sixth is exceedingly good, No. 53, 54. In these progressions there is continued series of perfect fourths between the third and sixth, which, if unaccompanied, would be very bad; but the bass accompanying at the distance of sixth and third below these parts, so covers the fourths that they produce no bad effect. If the bass of No. 53. were removed octave lower, the effect of the fourths would be more discernible, though this is often exemplified by the best authors. In Ex. 54. the bass is removed octave lower, and four parts are obtained by taking octave to it and doubling the sixth alternately. This example is also taken from Mr Shield: "How disagreeably this group (of fourths at the top of the chords,") says he, "howl without their associate, but how pleasantly they sing in four parts." In such progressions the dissonant chord of sixth is used as freely as the others. Here it is avoided by flattening the E, but if the student play E♮, he will find the effect very good.

39. The second inversion of the common chord, viz. the chord of fourth and sixth, is far more restricted in its use than the first derivative. It has been a dispute, whether this chord ought to be ranked among the concords or discords; and certainly the fourth to the bass as decidedly leads to the expectation of a succeeding third on the same bass as any discord points to its resolution. This chord, like the others of which we have treated, has three principal positions, also distinguished by open or close harmony, No. 55. On a resting bass this chord is struck freely. Its chief place is on the key-note and on the fifth of the key, and it alternates with those common chords, as in No. 56. In the major mode the reader will observe the sixth is major, and in the minor it is minor, both on the tonic and dominant. This chord is of great use in connecting chords and smoothing the passage of one to another. Thus, in the progression of the common chord on the fourth of the key to that on the fifth, it entirely removes the suddenness of the progression, No. 57. Compare No. 39. This progression is called the FOURTH AND SIXTH CADENCE, and it is one of the most solemn and effective closes. Though common chords in general do not require to be figured, it is usual to figure that which follows the chord of fourth and sixth, as in these examples. When an accidental is required to make the third major, as in the dominant of A minor, it is signified as here by the ※ under the 5.

The chord of greater fourth and sixth is dissonant like the common imperfect chord from which it is derived, and will fall to be treated of in the subsequent chapter.

## Chap. IV. Of Discords.

40. Among the intervals found in the diatonic scale, as observed Art. 28. several are *discords*, which are less pleasing and satisfactory in themselves, but of which a proper mixture with concords has a good effect. This general good effect may be referred to several different causes. Dissonant intervals conjoined with the concordant ones, take off from the too great lusciousness which would result from the latter alone; they are the means of rendering a progression less conclusive, and, consequently, keeping up the attention when the composer wishes it; and they, by their resolution into concords, make closes still more striking and conclusive than they would otherwise be. They are also frequently a mean of uniting chords more closely in their progressions, and, by all these characters, are a fruitful source of variety to the skilful composer.

41. Of all discords, by far the most important is the dominant seventh. This chord is produced, by adding to the common dominant chord the fourth note of the scale, which is minor seventh to the bass of the chord. The chord then consists of major third, perfect fifth, and minor seventh, and thus has four *real* parts. When the octave is taken along with these, there are five parts; consequently, in compositions of four parts, one or other will fall to be omitted, of which we shall speak immediately. The chord is figured by 3, 5, 7, written over each other—often simply by 7; but in the minor mode, a ※, or where there are many flats at the clef, a ♮ is written under the 7, to signify that the third is major—No. 58.

42. This addition of the fourth note of the scale produces more than one dissonant interval with the notes of the chord, to which it is added. To the bass it is minor seventh; and this discord is resolved by the diatonic descent of the seventh, while the bass rises fourth, or falls fifth, to the key-note; by which movements therefore we have the tonic with its third. In the major mode, the seventh resolves by semitone on the major third; in the minor, it descends by a tone on the minor third. See No. 59. *a, a.*

To the major third of the dominant chord, this additional note makes interval of imperfect fifth. This also requires resolution, which is effected by the major third rising by semitone to the key-note, while the seventh to the bass is descending as before described, so that these two parts meet in a third major or minor, No. 59. *b, b.* As both the seventh and third have thus determined movements, it is a general rule that neither of these intervals ought to be doubled. In omitting notes to accommodate the number of parts in the composition, the octave or fifth ought to be left out rather than the third, because this characterises the chord. Cases, however, will occur, when the third may fall to be omitted. If the seventh be omitted, we have the common chord on the fifth of the key, which, however, does not lose its character as dominant or leading chord.

If by the position of the chord, the lesser fifth be inverted into greater fourth, as at No. 59. *c, c,* the parts still resolve by the same movements. The third ascends by semitone, and the seventh descends semitone, or tone, producing by the resolution a minor sixth or major sixth as the mode is major or minor.

The fifth of the chord and the octave have no determined motions like the dissonant parts. The fifth may rise to the third of the succeeding chord, or descend diatonically on the key note, which is generally better; or it may leap to the fifth of the key, by opposite motion to the bass, sometimes crossing the other parts, as at 60, *a, a, a.* The octave in the dominant usually keeps its place, and becomes fifth in the tonic; sometimes it leaps to the octave by opposite motion to the bass, as at 60. *b.* The examples No. 60. exhibit the chord in four parts, with its resolutions, in its different positions, which the student will easily understand by the above observations.

The common dominant chord resolves well on the first derivative of the tonic, as at 61. *a*; but this cannot so well take place with the chord of seventh, because the resolution of the seventh on the eighth is too like consecutive octaves. Yet this is sometimes found in full harmony by the best masters. Sometimes, when the bass takes the note on which the discord should resolve, the seventh descends by fourth, and doubles the sixth, as at 61. *b.* This is a licence, but it has a good effect.

The chord of dominant seventh is frequently resolved into the fourth and sixth, the bass remaining in the same degree; and the chords are sometimes reiterated alternately several times. It is hardly necessary to say that this is never the final resolution. That generally takes place at the end. In No. 24. we have an example of this alternation many times. The student may observe, that when the seventh A ♭ is not found in the notes of the air, it is in the accompaniments; and when the air takes that note, the accompaniments take F the fifth, so that the discord is not doubled. In the second strain, the same progression is repeated in the fifth above.

43. As the dominant seventh has four real parts, it has three inversions or derivatives. The first is produced by making the third of the fundamental chord the bass; and it consists of minor third, imperfect fifth, and minor sixth, and is called the chord of the false fifth, or the chord of imperfect fifth and sixth. It is figured by 5 written under 6, to which the third is understood; or by a 5 with a stroke through it, to signify that it is not the perfect fifth, both the third and sixth being understood, No. 62, *a, a.* The bass is the sensible note, and the lesser fifth is the discord. The resolution is, therefore, by the ascent of the bass semitone, and the descent of the fifth by semitone or tone to the third major or minor of the tonic common chord. Neither of these parts ought to be doubled. The third and sixth have no restricted movement, and may be doubled at the composer's pleasure. The examples in No. 62. shew

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these resolutions in various positions. At *b*, where the sixth of the chord is highest, that note descends by fifth to the key, which has a very good effect; but if it were made to descend on the third of the chord the movement would be against rule, as stated under the fundamental chord.

The second derivative, when the fifth of the dominant is made bass, consists of minor third, perfect fourth, and major sixth, figured by 3 under 4, the sixth being understood; or in the minor mode, or in general when the major sixth is an accidental, by 6※, or by a 6 with a dash through the top of the figure, as in 63. In this chord the sixth is the sensible note, and rises semitone to the key-note; the fourth is the discord, and descends diatonically to the resolution; and neither of these sounds ought to be doubled. The bass may descend to the key, or ascend to the third of the key, bearing chord of sixth. When, however, the discord is highest, if the bass rise to the third of the key, the discord ought hardly to resolve on the octave, but may descend by a fourth to the sixth to that bass, as at 63. *b*, a licence similar to that at 61. *b*. In the second derivative of the dominant, the fourth, which is the fundamental of the dominant, is frequently omitted, and then the chord becomes the sixth on the second of the scale, as shewn in No. 51.; which chord of sixth, as we have already said, is still a dominant resolving on the tonic harmony. When the third of the chord is omitted, we have a chord of 4th and 6th major, which may still be treated as a dominant resolving on the tonic harmony, as at 63. *c*.

The third derivative, when the discord is put in the bass, consists of major second, major or dissonant fourth, and major sixth. It is figured by 2 under 4, to which a cross is annexed thus, 4+. This is not necessary in the principal key major, but is requisite in the minor mode, or whenever an accidental is necessary—No. 64. The bass being the discord, descends diatonically on the third of the key, bearing chord of sixth; and the major fourth, being the sensible note, ascends by semitone to the key-note, which is the sixth. Neither of these sounds ought to be doubled. The sixth of the chord, which is the fifth of the fundamental dominant, generally descends to the sixth. It ought hardly to ascend to the octave; but it may leap, as at 64. *a*, to double the third. The second of the chord keeps its place as third in the new chord. It would be bad to make it descend on the octave, as at *c*, as it would feel like consecutive octaves, as already stated. Sometimes the bass of the chord is, by a licence, similar to those formerly described, made to descend fourth to the key-note, while another part takes that on which it ought strictly to resolve, as at 64. *d*.

41. The seventh in the dominant may be struck freely, or it may be prepared, that is, heard as a concord in the preceding chord. When the dominant chord of seventh, or any of its derivatives, follows immediately the tonic harmony, direct or inverted, the discord is not prepared. We shall set down a few examples as specimens, No. 65. leaving it to the industry of the student to investigate the rest, which he may easily do if he has gone along with the preceding exhibition of the chords.

The dominant seventh is very frequently prepared in the sub-dominant common chord on the fourth of the scale, or in the chord of sixth on that note, which is the first inversion of the minor common chord on the second of the scale, as in No. 66.; and this brings us to the exhibition of other chords of the seventh.

42. By adding to the common chord on the second of the scale a seventh, (which is the key-note,) we have in the major scale a chord consisting of minor third, perfect fifth, and minor seventh. This chord, though less frequently used than the dominant, is of great importance in musical progressions. The seventh in this chord must be prepared, and it resolves by the diatonic descent of the seventh, while the bass leaps fourth upwards or fifth downwards. As the interval from the fifth to the seventh is concordant, the former is not constrained to rise diatonically as in the dominant chord. It resolves most naturally on the dominant, and its chief use is as leading to that chord. No. 67. shews the chord and its inversions. Of these the first inversion is by far the most usual form of the harmony, even more so than the chord of seventh, from which it is derived. It consists of major third, perfect fifth, and major sixth. It is figured by 5 under 6, and is usually called the chord of the great sixth. We shall call it the *sub-dominant fifth and sixth*.

The second derivative is hardly in use; but the third, where the discord is in the bass, is pretty frequently met with. It consists of major second, perfect fourth, and major sixth, and is figured by 2 under 4. No. 68. shews the chord with these derivatives, proceeding from the tonic harmony, and resolving on the dominant.

In the minor mode, the same chords and progressions, as given by that scale, take place. The key-note added to the imperfect common chord on the second of the scale produces a chord, consisting of minor third, imperfect fifth, and minor seventh, figured by 5 under 7, with a dash through the 5 to denote that it is not the perfect fifth. The chord with its inversions are set down No. 69. The second inversion is hardly in use.

The first derivative consists of minor third, perfect fifth, and major sixth, figured 5 under 6, and is the most in use of the three chords. We call it the subdominant chord of fifth and sixth minor mode. The third derivative consists of major second, perfect fourth, and minor sixth; it is of good effect, and pretty frequently met with. The chord with its derivatives following the tonic harmony, and resolving on the dominant, are shewn No. 70. We must leave it to the industry of the student to investigate other positions and inversions of the progression, after these examples.

43. As there are two other minor chords in the scale besides that of the second, viz. the relative minor and that on the third of the scale, we may, by adding to each of these its seventh as it lies in the scale, have chords of the seventh exactly resembling the subdominant of the major mode. Their inversions, of course, are exactly of the same nature.

There is yet another kind of chord of the seventh, which is formed by adding to the major tonic chord, or to the common chord of the fourth of the major mode, the seventh as it lies in the scale. The chord then consists of major third, perfect fifth, and major seventh. It is much more harsh than any we have yet treated of, especially when, by the position of the chord, the interval of lesser second is produced between contiguous parts. The seventh must be prepared, and the chord resolves in a manner analagous to the others. The chord, with its derivatives, are set down No. 71.

44. Thus giving to every note of the scale its seventh, we may have a continued series of such chords going round the scale, the bass descending fifth and ascending fourth alternately, No. 72. The seventh in every instance is prepared in the third of the preceding chord. This is called a diatonic sequence, or progression of sevenths. By taking away the bass, as in No. 73. and making the third part, or lowest in the triple line, bass, we have a very beautiful descending series in three parts of seventh succeeded by sixth on the same bass, accompanied by thirds, which is thus seen to be a progression derived from the sequence of sevenths.

45. The chords of which we have hitherto treated are the chief materials of harmony while the modulation continues within the key major or minor. When from the principal key we pass to another related to it, we must have in that new key a new tonic, with dominant and sub-dominant chords related to it, exactly as those of the principal are to it. As in the principal key the most conclusive of all progressions is from the dominant to the tonic harmony, so a new key is introduced and established by means of its dominant chord; and as the most remarkable parts in the dominant are its major third, which is the major seventh of the scale or sensible note, and its minor seventh the discord, so the *accidental*, which brings into the new scale this sensible note or minor seventh of the dominant, is the known mark of the change of key.

From any principal key, major or minor, the most natural changes of modulation are to those keys which differ from it by no more than one sharp or flat; and to every key there are five thus related, viz. the relative minor or major, the fifth with its relative, and the fourth with its relative, each in that mode which the primary scale gives it. To the principal and its relative these secondary keys are the same. Thus, to C the related keys are G major, F major, E minor and D minor, and A its proper relative. To A minor the related keys are the four first, and C its relative major. We shall give an example or two of each of these changes; but, before doing so, we must explain a rule for the movement of chords which we have not hitherto had occasion to notice. This rule is, that two parts ought to be *concordant taken cross-wise.* We shall give M. Choron's explanation and examples of what he calls *relations*: "By the term relation, which has not yet been defined, is meant the interval which is formed between the note taken by one part and the note quitted by another; thus, in the example 74. *a*, the first note of the lower part is in relation of sixth with the second note of the upper, and the first note of the last part is in relation of fifth with the second note of the lower part. We see from this, that there are as many relations as intervals; but all are not equally admissible; those of the octave enlarged or diminished chromatically, that of the lesser fifth and that of the greater fourth, are forbidden; the reason is, that they cause the parts to appear out of tune. Hence they are called false relations or bad relations. To be sensible of the bad effect, it is sufficient to repeat several times each of these examples, (74. *b b.*)" When there are two major thirds in succession in similar motion, each part rising or falling by tone, there is the false relation of greater fourth crosswise; and in successive minor sixths in the same manner, there is the false relation of imperfect fifth; and these will be found to produce a very bad effect taken naked in two parts. Yet these are allowed in the diatonic succession of sixths, or in the progression of the sub-dominant chord to the dominant of the key, and in natural changes of modulation, especially in the inner parts, or between one extreme part and an inner part. But false relations between the extreme parts in changes of key are to be carefully avoided. The more distant and sudden the change, the more offensive these false relations become.

46. The most natural and most practised change of key is from the major principal to its fifth, also in the major mode. This change may be effected several ways; thus, having struck the common chord on the fifth of the key, we may thence proceed to its dominant, and then the progression will be exactly the same as those in No. 65. These examples may therefore serve for every change of modulation, when we have got to the common chord of that key which we meant to establish; we shall not therefore repeat these in the sequel. After the same manner, the examples in No. 68. and 70. will serve in general for passing from the subdominant to the dominant of the new key. Thus the chord of the principal key, or the chord of sixth on the key note, are subdominant chords in the new key, whence we can pass to its dominant.

47. We may go from the subdominant of the principal to the dominant of its fifth. The fundamental progression, however, is not very good, as in 75, 1. on account of the false relation of octave between the bass and the major third of the new dominant, as pointed out by the stroke. In general, it is to be observed, that when a note is thus chromatically sharpened or flattened, the change should take place in the part where the note is, and that note ought not to be doubled in another part. Thus the derived progressions at 2. and 3. are very good.

On the figuring of the bass these examples furnish an opportunity of one or two general observations. 1. Accidentals are indicated by ※, ♭, or ♮. If any of these stand alone, it always signifies the third to the bass,—when put before or after any other figure, it denotes the change on the note represented. 2. When the bass is changed while the upper parts remain the same, a stroke drawn from each figure over the new bass note signifies their continuance, as at 2. At 3. the second is continued, (as also the understood 6th,) while the change on the nature of fourth is indicated by the + annexed to it.

Nothing can be more easy than to go to the fourth of the key. It is only adding a minor seventh to the tonic harmony, which then becomes dominant to the new key. All the inversions of the progression are good—No. 76.

The progression from the major tonic directly to the dominant of the relative minor feels sudden and harsh, though it is practised. Some of the derived progressions are very good; but care must be taken to avoid false gross relations by the chromatic change from the fifth of the primary to the leading note, No. 77. In the last of these progressions, substituting in the bass G, carrying fourth and sixth for E, the chromatic alteration will take place in the same part, and the false octave be avoided, and then the progression will be very good.

The fundamental progression from the tonic major to the dominant leading to the second of the key is objectionable on account of the false relation of octave crossways; and several of the derived successions for the same reason. Where that relation does not take place, the progressions are very good—No. 78.

Of the five keys related to the principal major, the most distant is that of the third of the key. One cannot go directly from the tonic to the leading chord of the new key, at least the progression in all its shapes is sudden. As this key is the relative minor to the common chord on the fifth of the principal, the progressions in No. 77, may easily be applied to it: Or we may go from the tonic by leap of false fifth to the second of the new key bearing the chord of imperfect fifth and minor seventh, and thence by sequence of sevenths to the new key. This, with the derived successions, is set down in No. 79. False relations must be carefully avoided.

48. It is not necessary to exemplify the progressions from the minor principals to its related harmonies. To its fifth, which is minor, the progression is the same as in the major. The same may be said of the change to the fourth of the scale; only, as the minor third of the tonic must become major in the new dominant, care must be taken to avoid bad relations crosswise, as has been exemplified in the preceding instances. From the tonic minor to the dominant leading to its third or relative major, the procedure is rather sudden, as the two chords have no common sound. Both the fundamental and derived progressions are in use,—the parts must go in opposite motion to the bass. No. 80. shews the best of them. The progressions to the dominants leading to the sixth and to the seventh of the minor scale are so easy and good in all their forms that we shall not make any particular exhibition of them.

The reader is not to take these examples as the only means of making the changes in question. They are given chiefly to illustrate the rules for the progression of chords, and of leading him to form such general notions on the subject as may direct him in his endeavours to investigate other progressions.—The industrious student will write and perform these in all the different keys, and vary the positions of the harmony. These he will find useful exercises, which will render familiar to him the principal parts of harmony, and prepare him for the advantageous study of the scores of the great masters.

49. We have seen the dominant chord resolved on a common chord, or on a chord of the seventh, such as it lies on the scale, when the third remains to prepare the seventh. But instead of this the dominant may resolve on a second dominant, in which case the third descends by chromatic semitone to become minor seventh in the new chord, No. 81. *a*. This process may be again repeated at pleasure; and by means of it the progression may make what is called the tour of the key-board, No. 81. An additional flat is introduced at each step, till we come to the dominant on G♭; which, on the piano-forte, being the same with F𝄪, the chord is written both ways.—Hence each step removes a sharp, till we come again to C, from which we departed. Compare what is said, Art. 8. to 12. inclusive.

From this sequence of dominants there are two successions derived, which may also be continued at pleasure, viz. the first and third derivative of the dominant alternately, and the dominant seventh and the second derivative alternately, No. 82, 83. If we try other derived successions, we shall find them objectionable, either on account of the resolution of the seventh on octave, as in No. 61. or on account of the false relation of octave arising from the chromatic change being not in the same part. In No. 84. are some licences to avoid the resolution of the discord on octave, similar to instances formerly given.

50. The progression of the dominant and other chords of the seventh, which we have described by the bass descending fifth or ascending fourth, is the best and most in use. There are others, however, which are now to be explained.

If in the dominant chord the seventh descend semitone and the bass ascend tone, the resolution will be on perfect fifth; and the sensible note at the same time ascending semitone, the imperfect fifth is resolved as before on major third, and we have a minor common chord, viz. that of the relative minor instead of the major tonic. This progression is used chiefly as a cadence at the conclusion of a verse, but never as the final cadence of a strain. It is called a broken or interrupted cadence, because it is generally substituted for the perfect cadence, where the strain might be expected to end. The strain is then generally continued through another verse, and concludes with the perfect cadence. No. 85. *a*, shews this resolution. At *b* is an outline of a broken cadence on the relative minor, followed by the perfect close on the tonic. In this progression the student must be on his guard against consecutive fifths or octaves. If the fifth of the dominant be present, it must descend to double the third. The octave ought hardly to be in the dominant which makes the broken cadence. If it be, it must leap by contrary motion to the bass, to double the third in the octave below, as at *c*.

The broken cadence is, after the same manner, practised in the minor mode. The seventh descends by tone, and the bass ascends semitone, on a perfect fifth; the imperfect fifth between the third and seventh being at the same time resolved by the former as usual ascending by semitone, No. 86. These progressions are seldom if ever inverted.

51. The other chords of seventh are sometimes

treated in the same manner, that is, by the bass ascending diatonically. Thus, in the minor mode, the subdominant, or fourth of the scale, instead of a common chord, chord of the sixth, or of the fifth and sixth, has not unfrequently a chord of minor seventh, which thus resolves on the dominant, No. 87. So also in the major mode, a chord of major seventh on the fourth of the scale may resolve on the leading chord, as in 88. The same precaution is still requisite to guard against consecutive fifths or octaves. When the bass moves diatonically there is always hazard of being betrayed into them,—but here it is doubled by the resolution of the seventh on a perfect fifth. It is for this reason that, in Ex. 88. the third of the chord of major seventh is omitted, as it would make fifths with the highest part in going to the octave to the bass.

52. After the same manner the chord of minor seventh with imperfect fifth, which we have already considered as resolving on the dominant chord of the minor mode, may, by the diatonic ascent of the bass by semitone, resolve on the tonic of the major mode, No. 89. In this case the chord is to be considered as a dominant, the bass is the sensible or leading note (third in the dominant seventh,) and the fifth is the dominant discord, and the seventh is a ninth added to the dominant. The whole combination of major third, perfect fifth, minor seventh, and major ninth, is sometimes used; and the chord of seventh in question is that with the omission of the bass. We shall first give an example or two of the use of the seventh.

In this chord the seventh may be prepared in the subdominant chord, as No. 89. *c*, or it may be taken without preparation directly from the tonic, as at *d*, by opposite motion. It frequently resolves on the first derivative of the dominant seventh, and thence to the tonic harmony, as at *e*. Lastly, the progression may be inverted as at *f*, *g*. If the discord be unprepared, it must be kept at the real distance of seventh, but otherwise it may be at the distance of second from the sensible note. If the discord be in the bass it must be prepared, and it resolves on the dominant seventh before coming to the tonic, as at *h*.

When the whole chord of ninth added to the dominant is used, the intervals ought to be taken in regular order; the ninth at the real distance of ninth from the bass or its octave, and of seventh from the third of the chord, at least if taken without preparation—No. 90. The fifth is generally omitted to lessen the harshness. The progression may be inverted with the same precautions. We shall leave them to the industry of the student to investigate.

53. In the minor mode, by adding to the chord of imperfect fifth on the sensible note, (that is, the seventh of the scale accidentally sharpened) the minor sixth of the scale, we have a chord consisting of minor third, minor fifth, and diminished seventh. This is a chord of much more importance, and of far more extensive use, than the chord of seventh on the leading note of the major mode. It is called the chord of diminished seventh. It is figured by ♭7, or when the note which carries it is sharpened by ♮7. The chord, with its inversions, is set down, No. 91. They are all used in all positions, with or without preparation of the discord, *i.e.* the diminished seventh of the primary chord.

The first derivative consists of minor third, imperfect fifth, and major sixth; the second of minor third, major fourth, and major sixth; and the third of redundant second, greater fourth, and greater sixth, and these are figured as in No. 91.

The diminished seventh descends semitone to the resolution, and the other parts resolve as they do in the dominant seventh, that is, the leading note ascends semitone, and the imperfect fifth, which is the seventh of the dominant, descends diatonically. The third, which is the fifth of the dominant, is not restricted. The chord, with its derivatives, is exhibited in the examples No. 92. The resolution into the minor tonic is not unfrequently interrupted by the 4th and 6th, as at *b*. The resolution of the ♭7 on the first derivative of the dominant seventh often precedes that into the tonic, as at *c*; and this resolution is practised in all the inversions of the diminished seventh, especially in the third.

54. As the chord of diminished seventh differs from that of a dominant seventh by chromatic semitone, the one easily passes into the other. Thus, in No. 93. the dominant of C becomes, by chromatic rise of the bass, the diminished seventh leading to A; and then this is reversed. By this progression one may easily go to the relatives major or minor. Thus, by means of this dominant leading to the fourth of the key major mode, we can easily go to its relative minor, viz. the second of the key; from that leading to the fifth to its octave minor, viz. the third of the major scale. The same is easily applicable to the natural changes from the minor principal.

The chord of diminished seventh belongs properly to the minor mode; but it is often used in the undulations within the major mode, or in leading to major keys. It may resolve on a major chord, and that major chord may even be a dominant. Thus, in 94. *a*, it is resolved on the third inversion of a new dominant, and leads to the fourth of the key; at *b* the same resolution leads from C to D minor. The progression is, however, harsh. It is greatly assisted by the appogiaturas, which are in effect resolving the diminished 7th on the major chord to which the discord is immediately added.

The whole chord of dominant seventh, with minor ninth added, is exhibited in Ex. 95. The inversions are all used and resolved after the same manner, in which the student can find no difficulty.

55. The chord of diminished seventh is the great instrument by which modern composers effect sudden and distant changes of key. This is brought about by means of enharmonic changes in some part or parts of the chord. We have explained, Art. 11. the nature of the enharmonic diesis,—by well understanding which the student will be prepared to go along with what follows.

Musicians usually acknowledge 24 notes in the musical scale, viz. $\underbrace{\text{B}\sharp\ \text{C}}$, $\underbrace{\text{C}\sharp\ \text{D}\flat}$, $\underbrace{\text{C}\times\text{D}}$, $\underbrace{\text{D}\sharp\ \text{E}\flat}$, $\underbrace{\text{E F}\flat}$, $\underbrace{\text{E}\sharp\ \text{F}}$, $\underbrace{\text{F}\sharp\ \text{G}\flat}$, $\underbrace{\text{F}\times\text{G}}$, $\underbrace{\text{G}\sharp\ \text{A}\flat}$, $\underbrace{\text{A B}\flat\flat}$, $\underbrace{\text{A}\sharp\ \text{B}\flat}$, $\underbrace{\text{B C}\flat}$. The pairs united by brackets differ in pitch by the enharmonic diesis, the first of each pair as here set down being the lower of the two sounds. The pairs thus united we shall call enharmonic relations. Now, in such a scale there are fifteen chords of diminished seventh, which by their enharmonic relations are distributed into three sets, as set down in No. 96.

Taking the bass note of each chord of diminished seventh as the sensible note, each will resolve into a key semitone above the bass. We have therefore five tonics in each set; but, by the enharmonic change of parts, any chord in each set may be changed into any other of the same set, and consequently lead to any of the keys.

We shall set down these resolutions and enharmonic changes in one set, concluding with a formal cadence in each key, as exhibited by Mr Shield in his Introduction to Harmony. In No. 97. the diminished seventh closes in the key of A minor, as in our former examples. In 98. the diminished seventh, by the enharmonic change downwards of F into E♯, becomes the first invertion of the diminished seventh on that note, and consequently leads to a close in F♯ minor. In 99. the diminished seventh on G♯, by the enharmonic rise of the bass to A♭, becomes the third derivative of the diminished seventh on B, and resolving on G ♮ the dominant, closes in the key of C minor. In 100. both the bass and third are changed enharmonically upward into A♭ and C♭, by which we have the second inversion of the diminished seventh on D, which consequently closes on E♭ minor. Lastly, in 101. by the enharmonic change of the diminished seventh and imperfect fifth downwards to E♯ and C×, we have the second inversion of the diminished seventh on the last named note, which consequently leads to D♯ minor. As far as respects the piano-forte, this modulation is the same with 100.

Though these closes are all made in the minor mode, the same progression may be made to the same tonics in the major mode: so that, by means of one chord of diminished seventh, we may conduct the modulation to five tonics, either with minor or major harmony.

56. By transposing this modulation into the other two sets, in which he ought not to find much difficulty, the student will see the means of modulating into 15 keys. In order, therefore, to go from any key whatever to any other, the only remaining question is the means of getting into the proper set of diminished sevenths. We have already shewn how easy it is to convert a dominant chord of seventh into a chord of diminished seventh by raising the bass chromatically. Now, in every key, the dominant of the key itself by the chromatic change will give one of the three sets; the dominant leading to the fifth of the key, another; and that leading to the fourth of the key, the remaining one; so that, by these chords, it is in the musician's power to make the most distant and surprising changes. It is on this account that the chord of diminished seventh is called the *equivocal chord.*

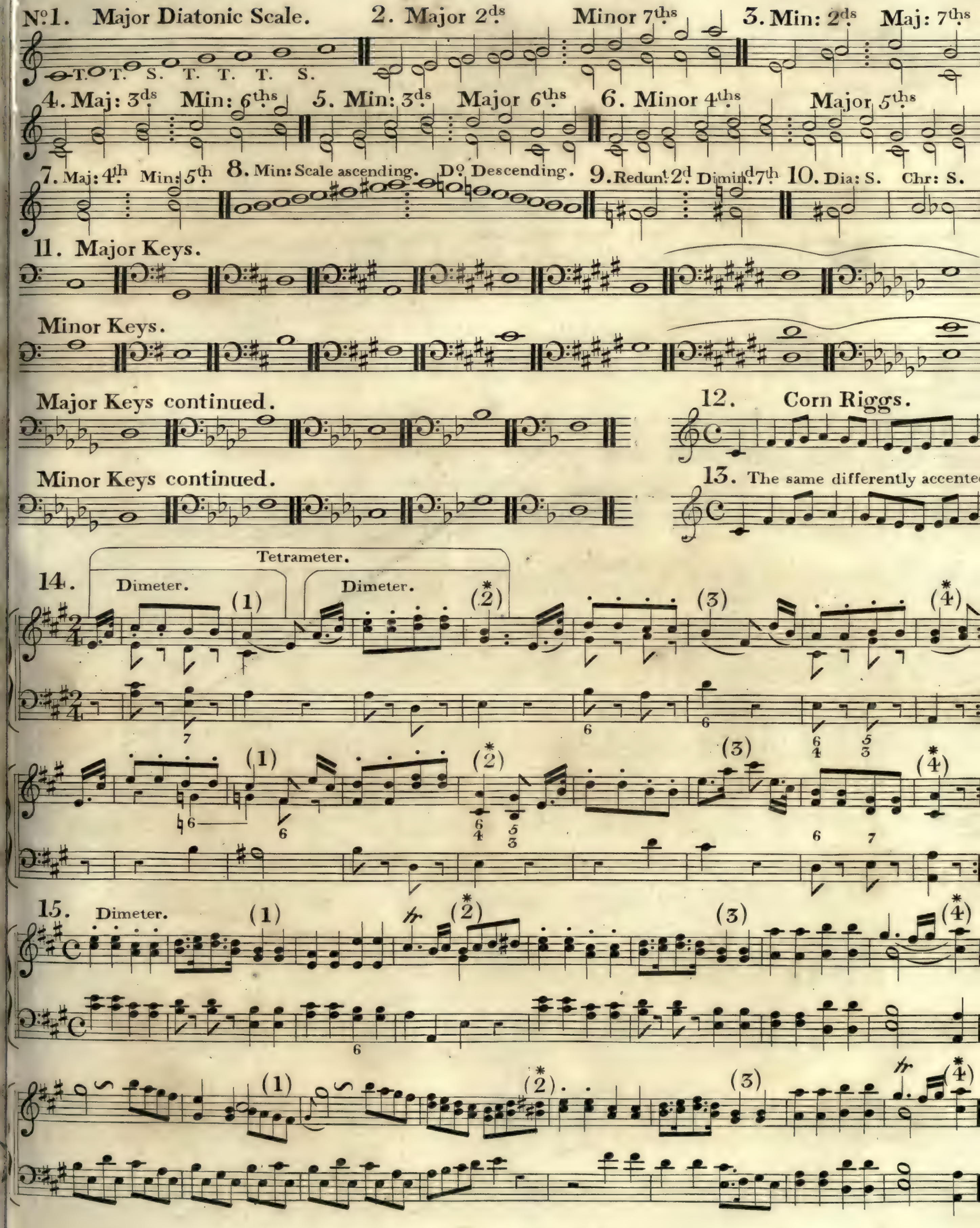
57. There is yet another resolution of the dominant, which though not very good, and therefore little practised in the fundamental progression, is yet very good in the derivatives, especially in the third inversion. If the discord resolve by semitone, and the third instead of resolving remain, while the bass descends minor third, and the octave rise chromatically, we shall have the dominant followed by a new dominant minor third lower, as in No. 102. *a.* This is objectionable, both on account of the resolution of the seventh on eighth, and on account of the false cross relaation, as pointed out by the stroke. At *b* the third derivative of the first dominant resolves very agreeably on the new dominant, and leads to the relative minor, the other inversions are also good though not practised.

A similar progression may take place in the third inversion of the other chords of seventh, as at 103.

57. There is a musical interval within the chromatic scale which we have not as yet described, which is of good effect, and produces a species of common chord and of chord of the diminished seventh, different from those we have seen. If, in the minor scale, the fourth be sharpened as if to go to the fifth of the key, while the sixth of the scale remains minor, we have between these two notes, the sharpened fourth and minor sixth, a species of third less than the minor third by chromatic semitone. It is called the *diminished third.* It is larger than the major second by the enharmonic diesis, though on the piano-forte it is played by the same finger keys. This diminished third inverted becomes a sixth greater than major sixth by chromatic semitone, called the redundant sixth, 104. *a.* If to this sharpened fourth of the scale, with its diminished third, we add its fifth, which is the key-note, we have a chord consisting of diminished third and imperfect fifth, little used except in its first inversion, which is a very agreeable combination, and to which we shall confine our observations. This consists of major third and redundant sixth, and is used chiefly in the position set down in 104. *b,* the sixth being highest. It may be struck freely immediately after the first inversion of the minor tonic: It is resolved into the dominant chord by the bass descending and the sixth ascending each by semitone to octave: the descent of the major third of the first chord to the major third of the dominant is generally retarded by the fourth, as in the example 105. This chord succeeds the subdominant sixth of the major mode by the chromatic ascent of the sixth, and thus leads in a very agreeable form the major mode to the relative minor, No. 106.

To the chord of diminished third and imperfect fifth, the diminished seventh is added. This is also chiefly used in the first inversion, which consists of major third, perfect fifth, and redundant sixth, No. 107. This chord is prepared and resolved exactly like the former, No. 108. which requires no observation, except that the fourth and sixth are necessary to prevent the perfect fifths and major thirds in similar motion.

58. We have thus taken a view of the most important chords used in harmony, and their various progressions. These progressions are sometimes modified by suspension of one or more of the parts, which afrerwards proceed in their natural manner. These suspensions often produce discords to the bass, which are called discords of suspension. Thus, in going from the tonic chord to the dominant, if, instead of taking all the notes of the latter immediately, as at 109. *a,* the octave of the first chord be continued as at *b,* it produces a discord of suspension called



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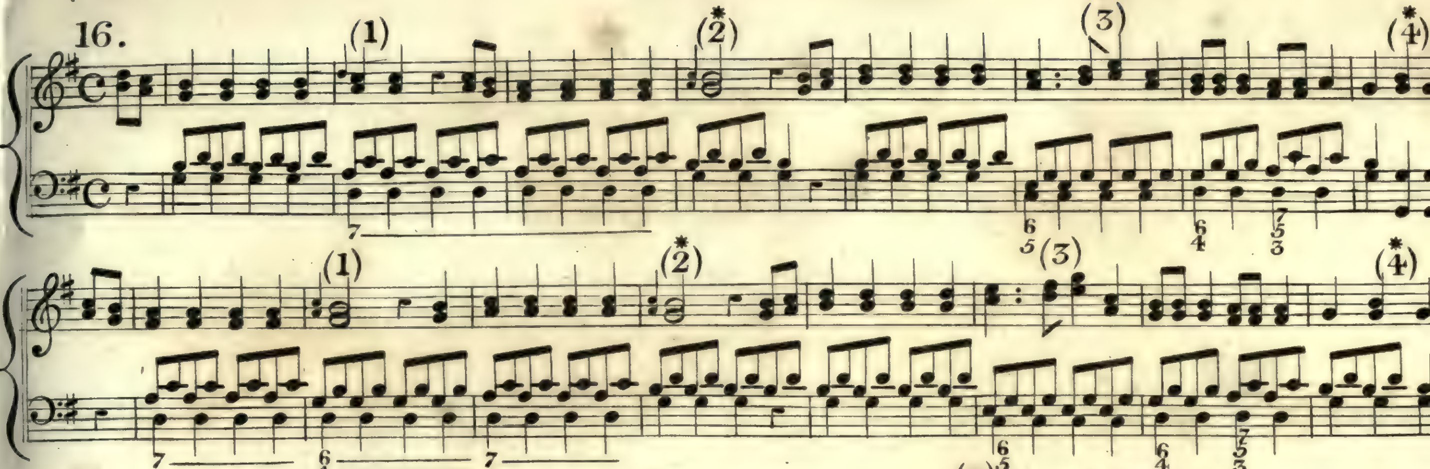

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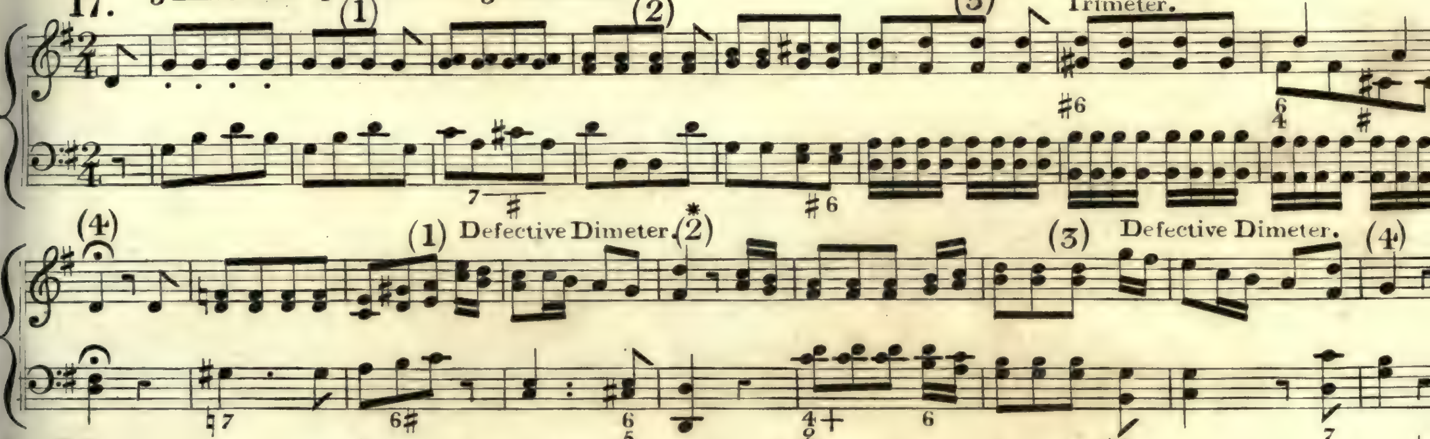

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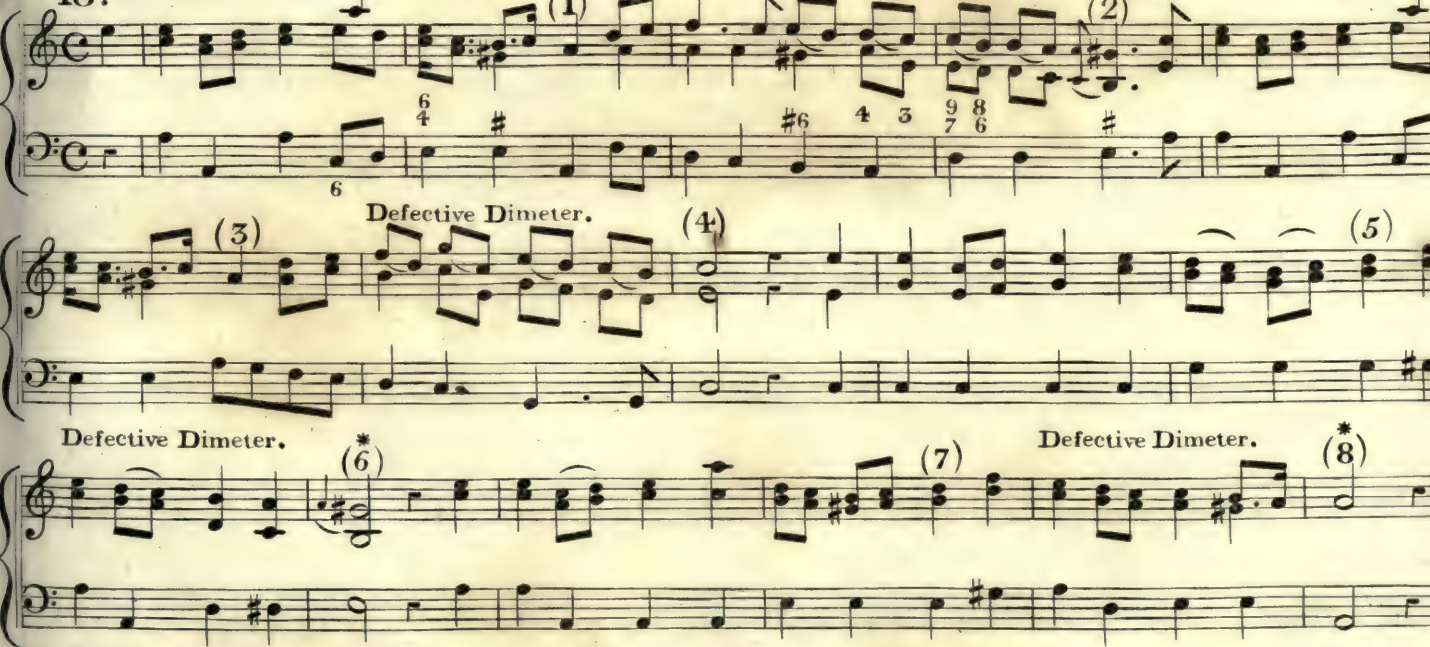

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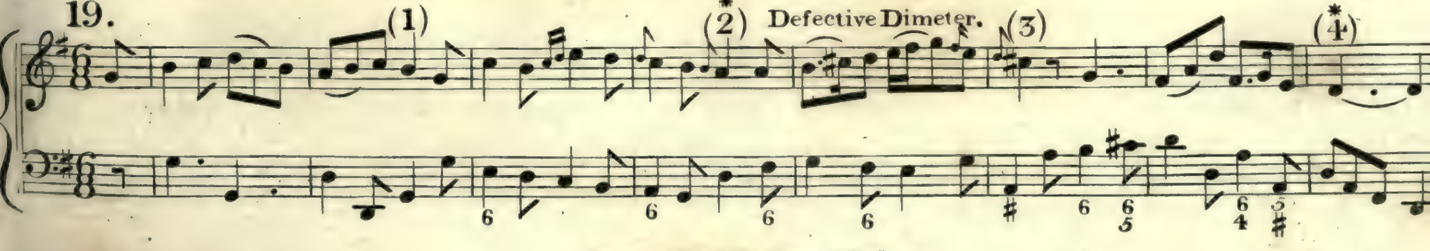

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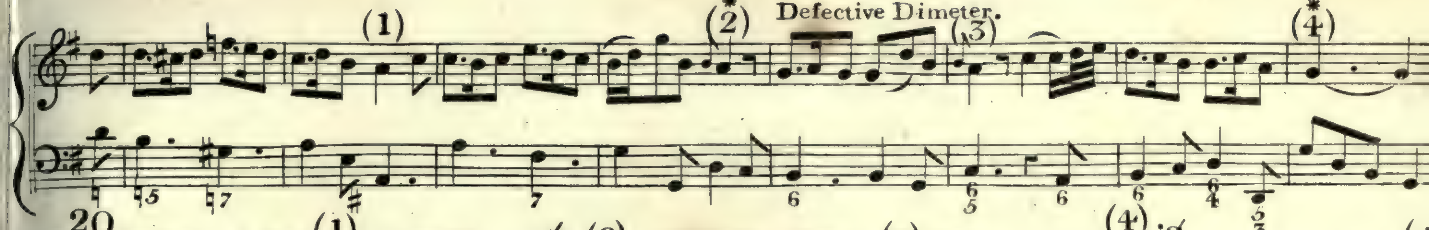

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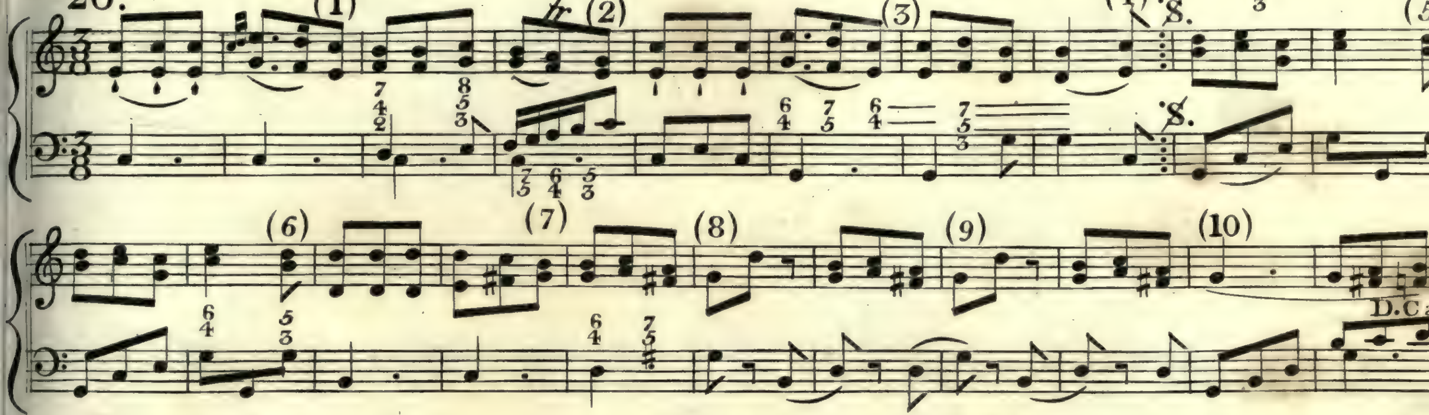

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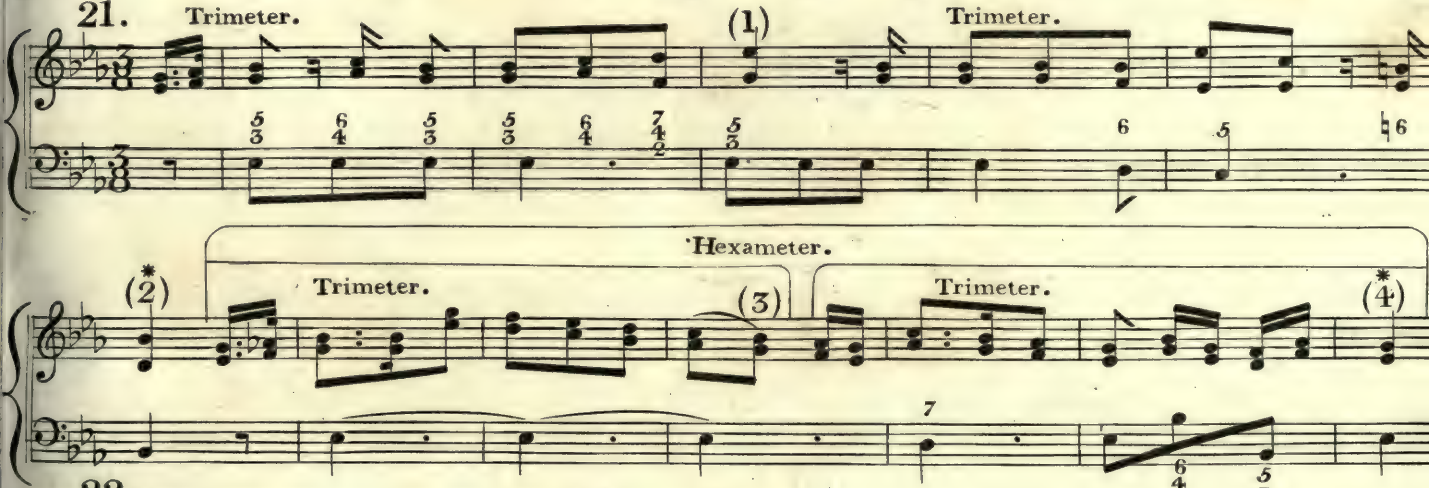

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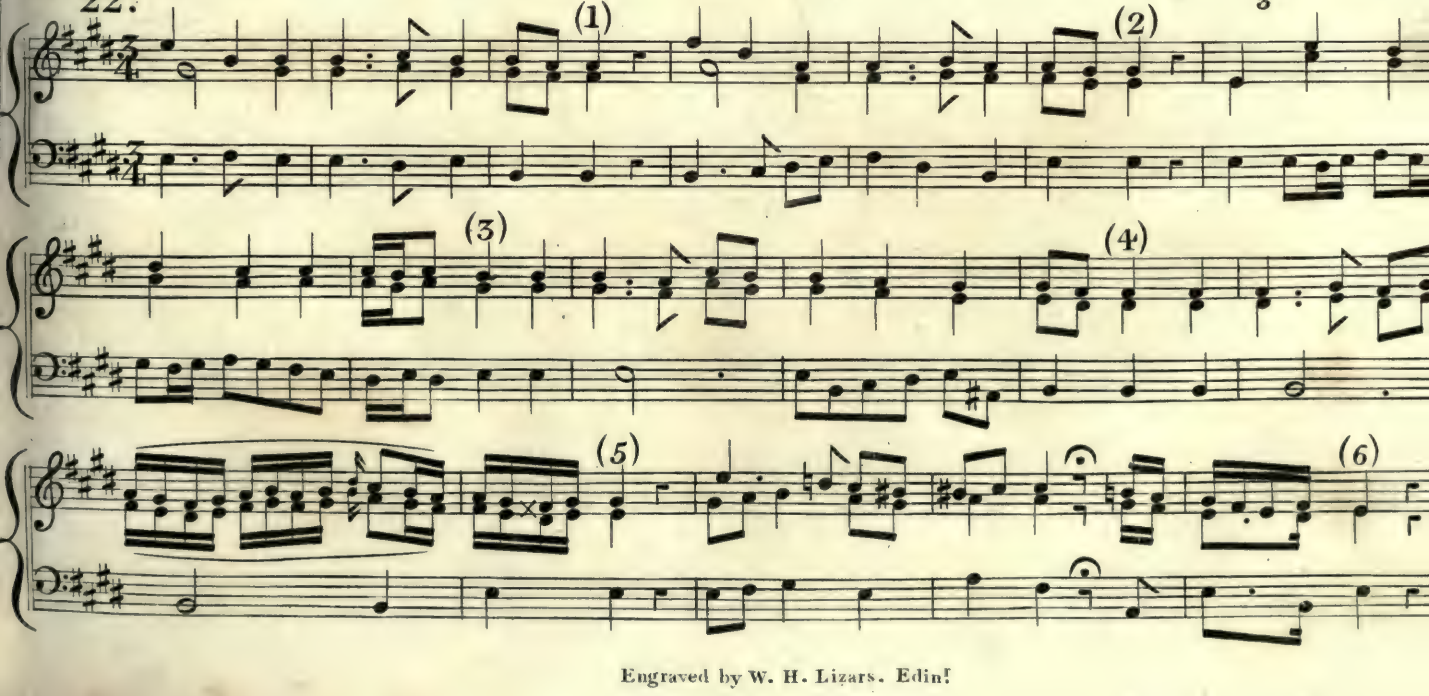

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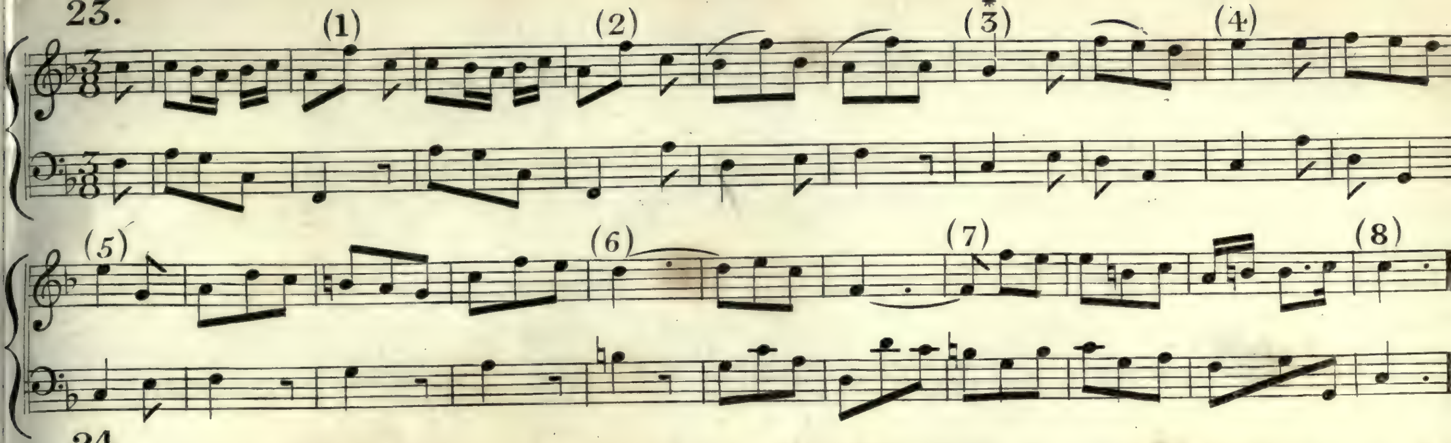

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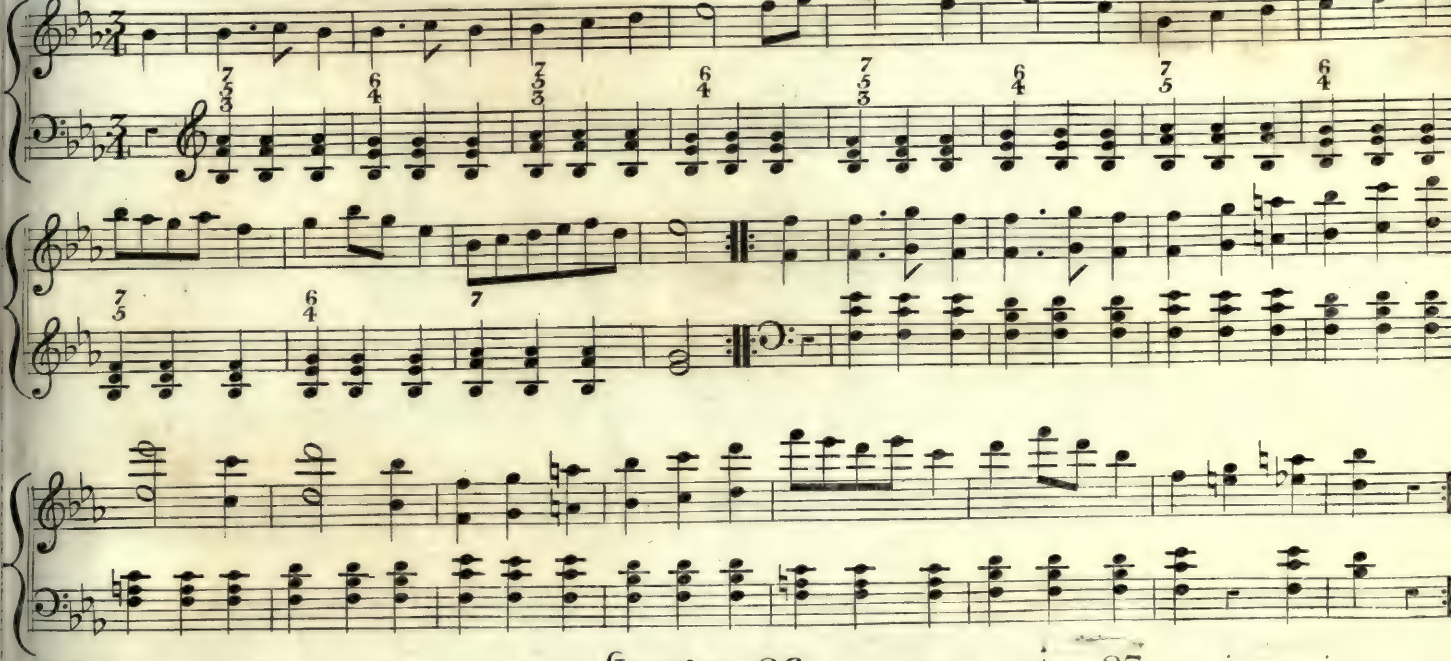

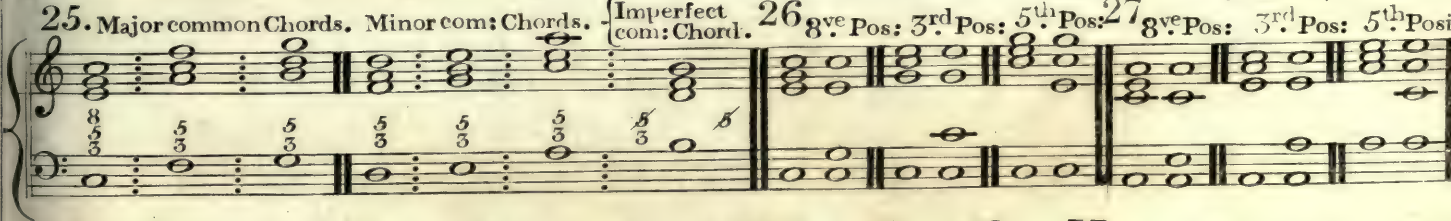

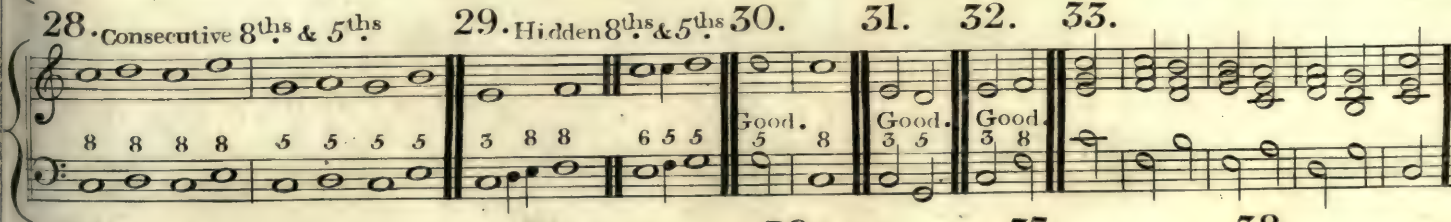

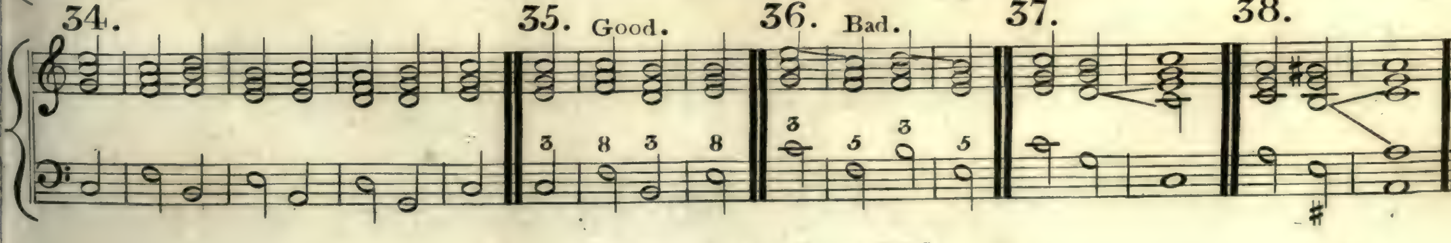

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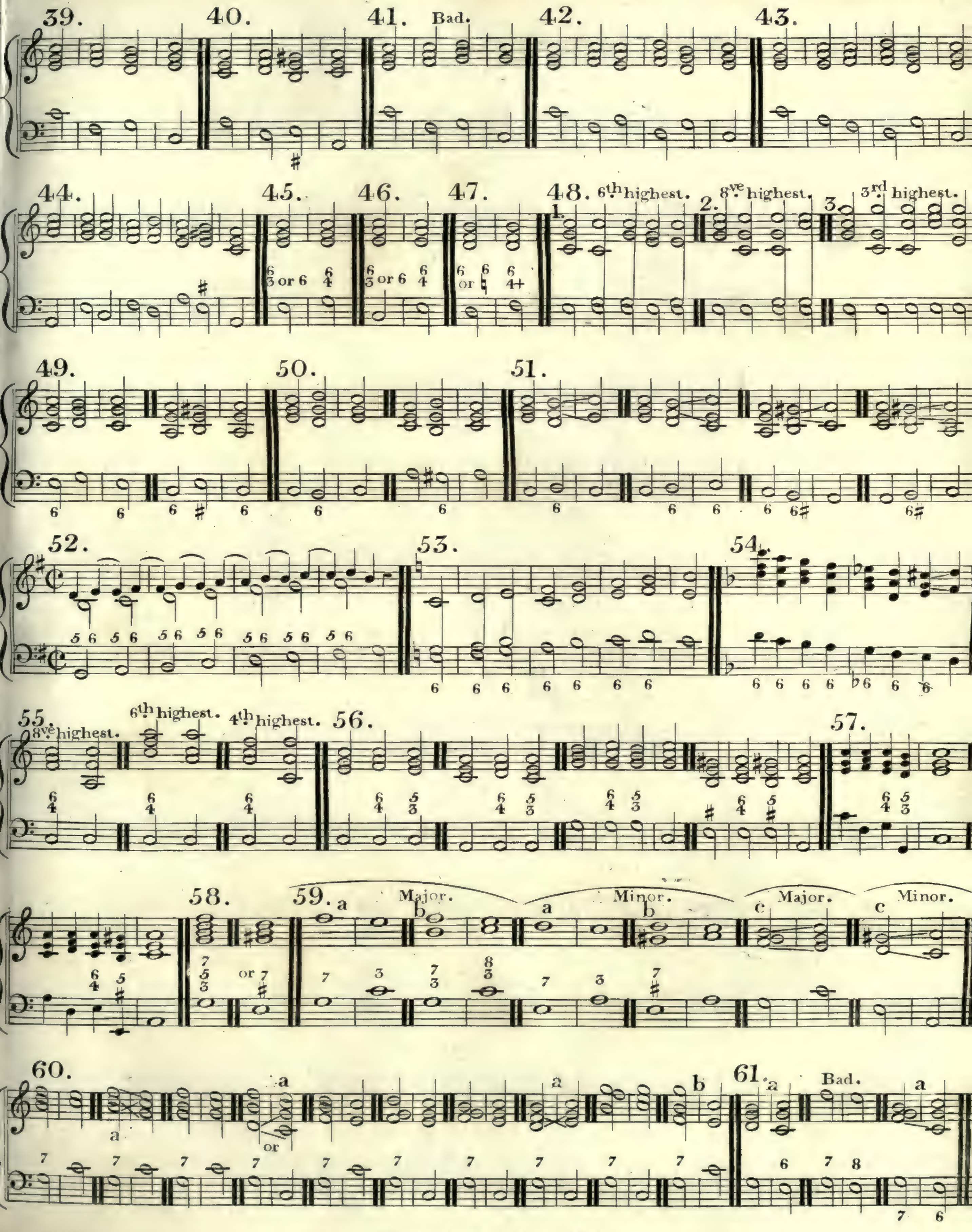
# MUSIC



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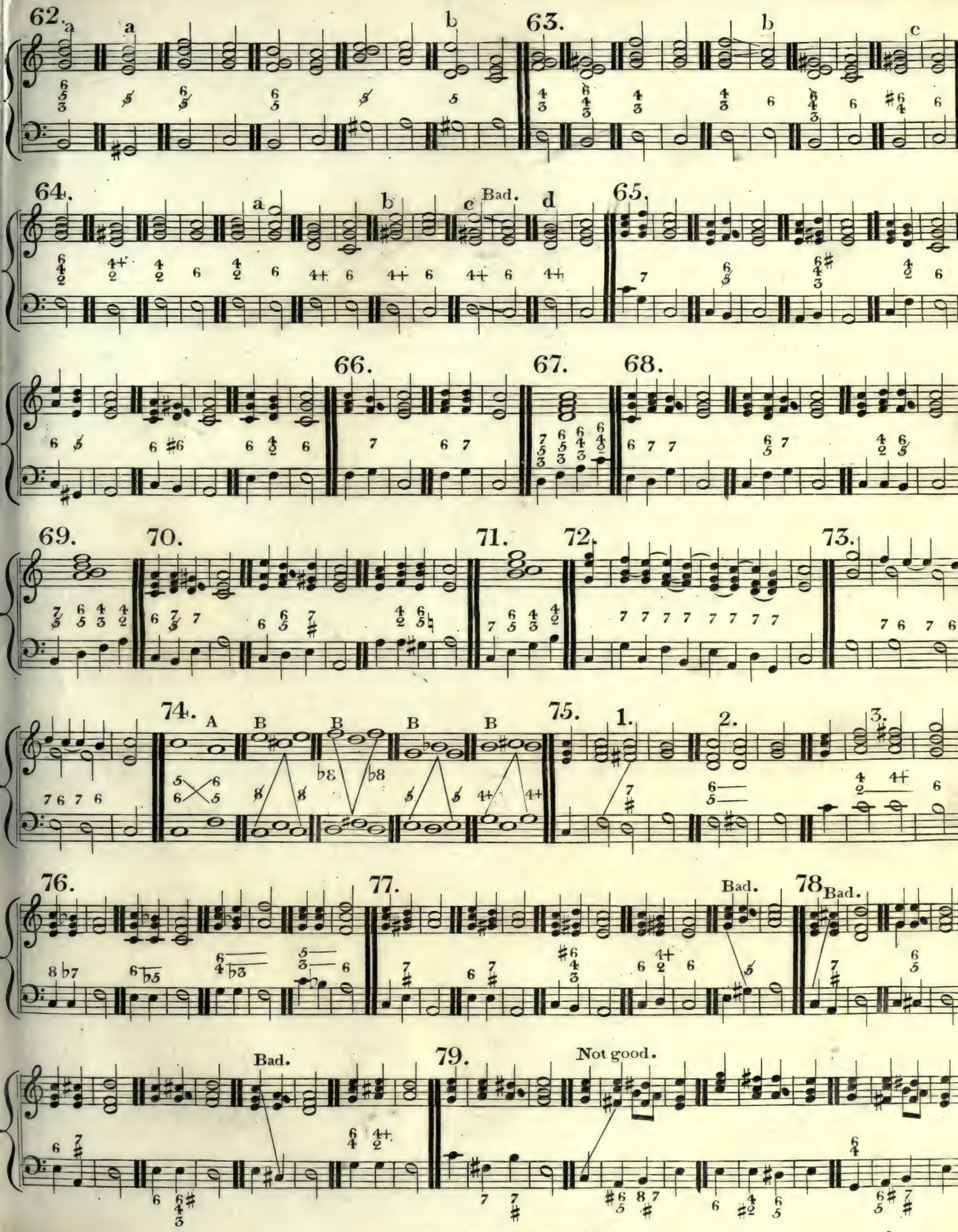
62.
a
a
b
63.
b
c
64.
a
b
c
Bad.
d
65.
66.
67.
68.
69.
70.
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74.
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Bad.
Bad.
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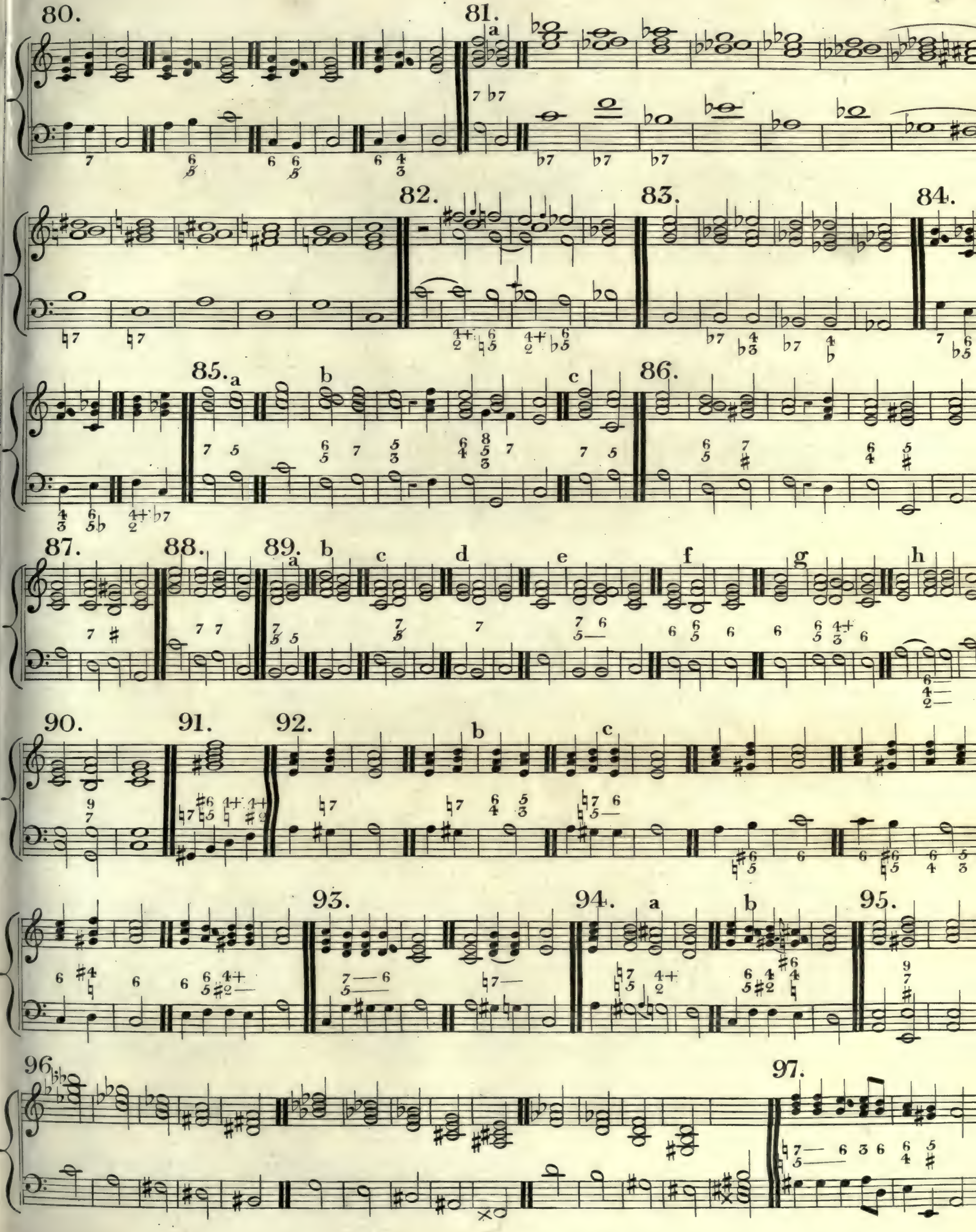
Not good.



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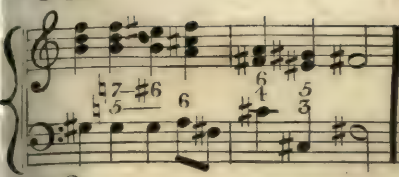

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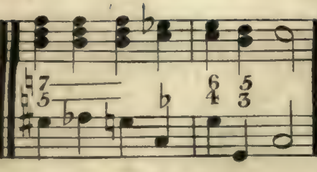

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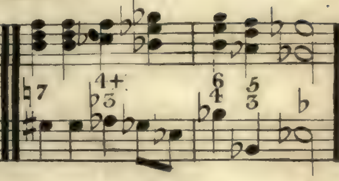

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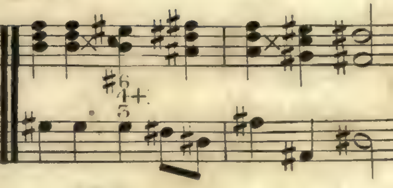

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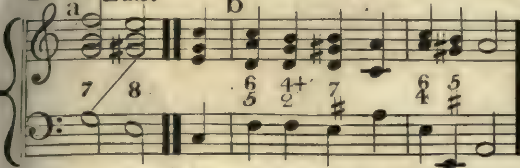

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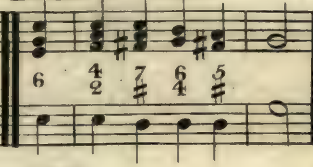

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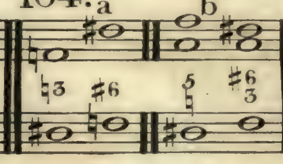

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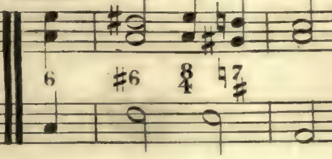

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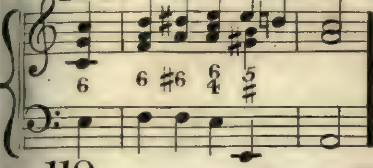

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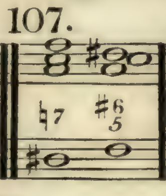

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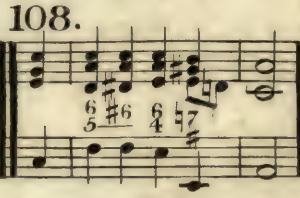

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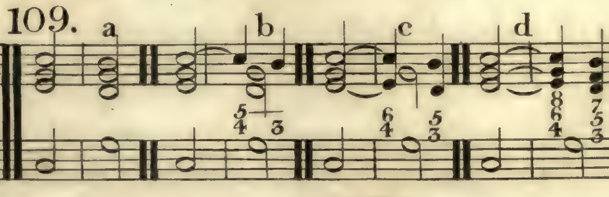

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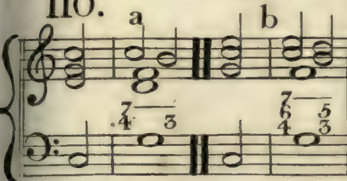

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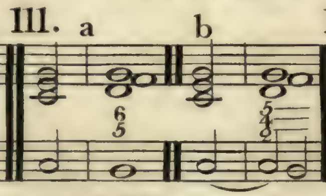

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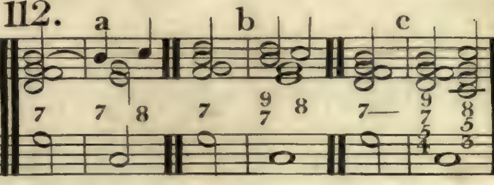

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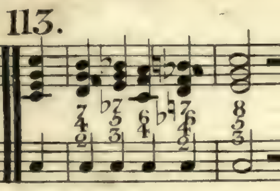
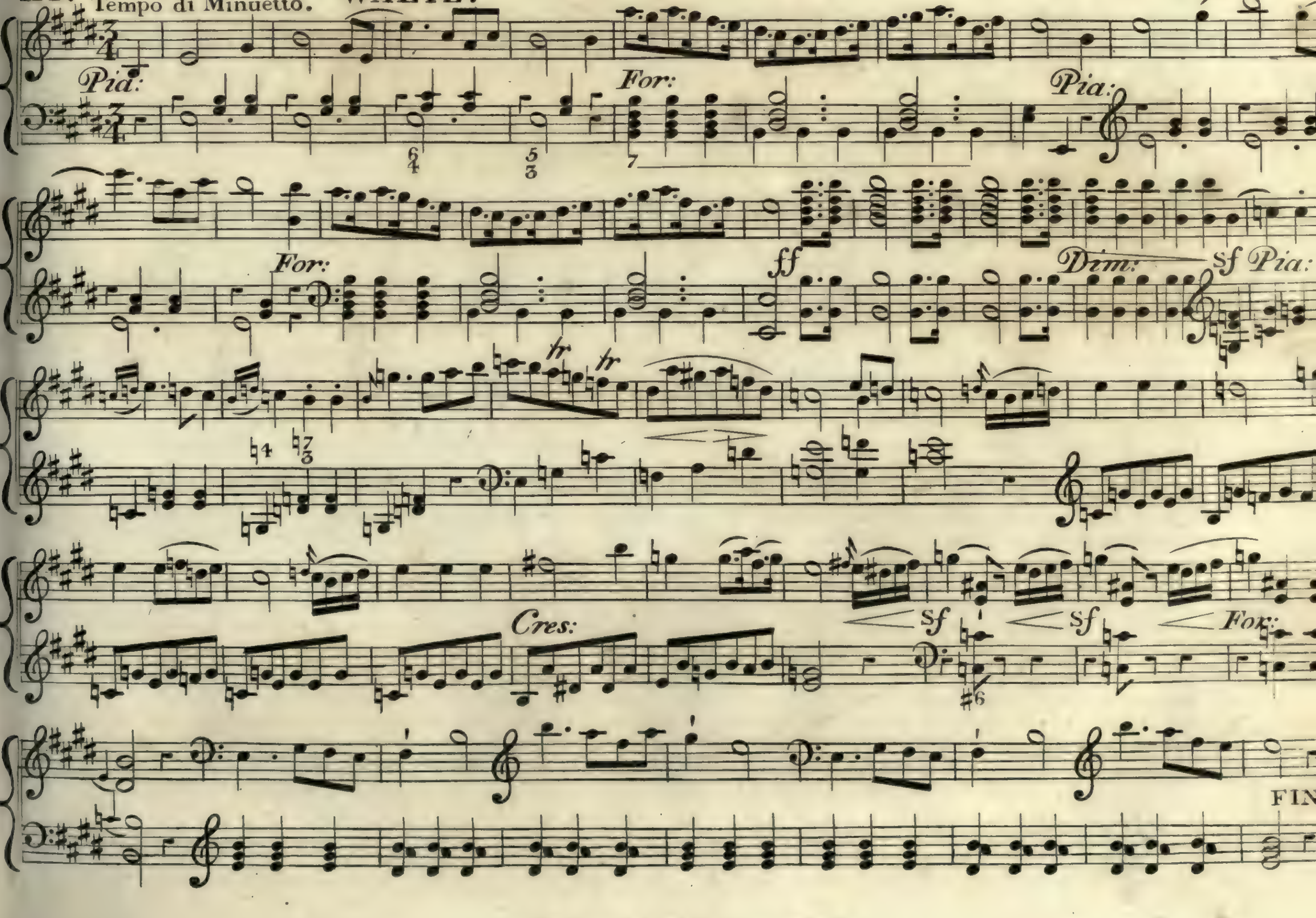


114. Tempo di Minuetto. WALTZ.



the chord of 4th and 5th, which is resolved by the diatonic descent of the 4th on the third of the dominant; and if along with the octave of the tonic the third also be suspended, as at G, we have a chord of fourth and sixth, which are felt as dissonant to the bass, and are resolved on the third and fifth. These are suspensions, because they are foreign to the dominant chord: but the continuation of the fifth of the tonic, as in both these examples, is not a suspension, because it belongs to the dominant chord: yet even this may be treated as an octave suspending the sevetnh, as at *d*.

The general rule for suspensions is, that they are to be prepared on the unaccented part of the measure, struck on the accented part of the next measure, and then resolved on the unaccented part.

We shall give a few examples of suspensions in going to the dominant sevetnh, and in the resolution of the latter on the perfect cadence. In No. 110. *a*, the octave of the tonic being suspended produces a chord of fourth, fifth, and seventh, the fourth being resolved on the 3d; at *b* both the eighth and third of the dominant being suspended produce fourth, sixth, and seventh, the two former resolving on third and fifth. Similar suspensions may take place in all the inversions of the progression. Thus in 111. the tonic going to the first derivative of the dominant as at *a*, by the suspension of the bass produces a chord of second, fourth, and fifth, which by the resolution of the bass becomes the small fifth and sixth, as at *b*.

In 112. *a b c*, one or more parts of the dominant going to the tonic are suspended, and produce the chords signified by the figures. The student will here observe the difference between a chord of the second and a chord of the ninth. The former discord is in the bass, and resolved in that part, as in No. 111. *b*; the latter is in the upper parts, and ought to be at the real distance of ninth, and not that of second to the bass.

In 113. is what is called an organ point, or pedal point, which consists of different harmonies taken over the key which is held on. In this instance, we have first the dominant chord, producing to the bass the chord which at 112. *c*, is figured with fourth, fifth, seventh, and ninth. In organ points the ninth is generally figured by 2, both because it may be at the distance of second, and because it often rises to the resolution, as here. This chord is succeeded by a dominant on the bass resolved into fourth and sixth, and then we have the chord of diminished seventh, or its first inversion, resolving on the key. This is called a tonic pedal point. When a similar licence is taken over the dominant chord, it is called a dominant pedal or organ point.

59. The student is now prepared to derive advantage from the scores of the masters of the art. He might, however, find many puzzling passages did we not make mention of *passing notes* on the unaccented part of the measure, which are not reckoned in the harmony, and which often do not proceed according to the rules we have explained. These are, by the French, called notes of supposition; and we cannot explain them more shortly than in the words of Rousseau: "When several notes ascend or descend diatonically in one part on one continued note in another part, then these diatonic notes cannot all be harmony, or enter at once into the same chord; there are, therefore, some of them which count for nothing, and these notes, foreign to the harmony, are called notes by supposition. The general rule is, when the notes are equal, that all those which are struck on the strong times bear harmony; those which pass on the weak times are notes of supposition, which are only introduced for the sake of the melody, and to form conjoint degrees. Observe that by *strong and weak times* I understand here less the principal times of the measure, than the subdivisions of each time. Thus, if there are two equal notes in one time, it is the first which carries harmony, the second is a note of supposition. If the time is composed of four equal notes, the first and third carry harmony, the second and fourth are notes of supposition. Sometimes this order is reversed; we pass the first note by supposition, and make the second bear harmony, but then the value of the second note is generally augmented by a point, at the expense of the first. All this supposes always a movement by conjoint diatonic degrees; for when the degrees are disjoined there is no supposition, and all the notes ought to belong to the chord."

60. We have, in the course of this chapter, mentioned the five keys most related to each principal key, to which changes of modulation are most frequently made; and the student will find most of the changes exemplified in the airs given to illustrate the subject of rhythm or versification. Beyond these limits, according to the older masters, the modulation was forbidden to pass; but modern composers allow themselves a much wider range. From the major mode, for instance, the air is frequently made to modulate into the minor on the same key-note, or *vice versa*; and then, by taking the five related keys to this new mode, a great variety of secondary keys is brought into connexion with the principal; and, not unfrequently, the modulation is carried to one of these keys before the change of mode be made on the tonic itself. The minuet in 114. is given as an instance of this modulation, where it produces a most happy effect. The primary key is E major, to which the first strain is wholly confined. The second strain begins with four measures, consisting entirely of the common chord of the dominant. Now this chord belongs equally to the major and to the minor mode of E; but instead of making a cadence on E minor, the B, which has been so impressed on the ear, is made the leading note to C♮ major, the relative to E minor; and in this key of C, which the ear feels all the while as the relative to E minor, the modulation continues for ten measures, when E minor itself comes most welcome to the hearer. From this the return to E major is equally ingenious and effective by the chord of redundant sixth, which, at the end of four measures, resolves on the dominant; and then the subject in the original key, a little varied, is as grateful and welcome as the changes which have pleased by their variety. By such arts as these the modern masters create an inexhaustible variety of delightful effects.

MUSICAL GLASSES. See HARMONICA.

MUSK, a substance employed as a perfume, and which is secreted into a kind of bag in the umbilical region of the moschus moschiferus. See MAMMALIA, and MATERIA MEDICA.

MUSKET, an instrument of offence, by which a ball is discharged through a cylindrical tube by means of the explosive force of gunpowder.

MUSLIN, a fine cotton manufacture, having a downy nap on its surface, and which is now brought to great perfection in this country. Several kinds of muslins are brought from the East Indies, especially from Bengal, such as doreas, betelles, mulmuls, and tanjeebs. The best kind of muslin for the purposes of tambour and needle-work is that called jacconott or jacconett.

MUSSELBURGH, a sea-port town of Mid-Lothian. See EDINBURGHSHIRE.

MUSSULMAN, or MUSYLMAN, a title of distinction among the Mahometans, which, in the Turkish language, denotes true believer, or orthodox. The Sonnites and Shiites are separate classes of Mussulmen. The former, who adhere to the interpretation of the Alcoran given by Omar, are the subjects of the Grand Signior, while the latter are followers of Ali, and subject to the king of Persia.

MUTE in common language denotes a person who has not the use of speech, and the same term is in law applied to one who stands speechless when he ought to answer or plead in his own behalf, and who is thus considered to plead guilty. Mute, in grammar, is a letter which yields no sound without the aid of a vowel, the simple consonants being distinguished into mutes and liquids or semivowels.

MUTINY denotes a contempt of or insurrection against authority; which crime is, according to the articles of war, brought home in various cases. The mutiny act is passed annually by Parliament, for the purpose of punishing mutiny and desertion, as well as for the better payment of the army and their quarters.

MYCENÆ, a town of Greece in the ancient kingdom of Argos. The kingdom of the Argives was divided into two portions, the capitals of which were Argos and Mycenæ. See Clarke's *Travels*.

MYRMIDONES were a people of Thessaly, so called from Myrmidon, a son of Jupiter and Eurymedusa, and who accompanied Achilles to the Trojan war. They are mentioned as Achilles's soldiers by Homer and Virgil.

MYSIA, in ancient geography, a country of Asia Minor, the chief cities of which were Pergamus and Lampsacus.

MYSORE, a province of Hindostan, situated between 11° and 15° of north latitude. See HINDOSTAN.

MYSTERY, in common language, denotes any thing secret or peculiarly difficult to be comprehended; but, in a religious sense, the term refers to those doctrines of divine revelation which appear inscrutable to human intelligence, and likewise to the secret rites connected with heathen superstition. The religion of the Egyptians was entirely of a hidden and mysterious nature; and from their priesthood the mysteries of pagan worship, no doubt, had their origin. These mysteries, which were reserved only for the sacerdotal tribes and nobility, greatly degenerated in course of time, not only by the evil dispositions of wicked men, but also by the sacred rites being under the auspices of such deities as were thought to preside over evil passions. According to Ovid, the divulging of the mystic rites of Ceres and Juno was highly criminal. The mysteries instituted in honour of Ceres were by the ancient Greeks and Romans solemnized with extraordinary veneration. See ELEUSINIA and GREECE.

MYSTERY, the ancient appellation of dramatic exhibitions in England. They were so called from the mysterious subjects they embraced, such as the incarnation, passion, and resurrection of Christ, and other important histories of the sacred volume. Of these mysteries, which were represented in the churches on solemn festivals, specimens are contained in Dodsley's Old Plays, and in Osborne's Harleian Miscellany. The rude poets of the fifteenth century composed moral plays or moralities, consisting of personifications of death, sin, charity, faith, and the like, such allegorical personages having been frequently introduced into the old mysteries.

MYSTICS, MYSTICI, an ancient sect of fanatics, the authors of which are unknown. Their principles, however, arose from the doctrine of the Platonic school, that the divine nature was diffused through all human souls, or that the faculty of reason, from which proceed the health and vigour of the mind, was an emanation from God into the soul, comprehending in it the principles and elements of all truth human and divine. The Mystics professed a pure, sublime, and perfect devotion, entirely free of every thing selfish. Previous to the Reformation, they formed a prominent figure in the religious world, and had propagated their tenets throughout most parts of Europe.

MYTHOLOGY, a term derived from two Greek words signifying *a fable* and *a discourse*, treats of the objects of pagan worship among the ancients. Though this subject is unavoidably involved in obscurity, the learned have satisfactorily demonstrated that the mythology of the ancient nations of the world originated from the traditions preserved of the antideluvian period and the deluge, as well as from the Sabian idolatry. Mankind, after the flood, having been dispersed by the confusion of tongues, the common parents of our race were, in the course of time, esteemed as fit objects of adoration, and in succeeding ages their attributes and names became associated with other objects of worship, as the sun, moon, and other heavenly bodies. From the east this species of idolatry was, by the migratory tribes, diffused over the globe, bearing with it manifest evidence of its origin.

Excepting the writings of Moses, few fragments of the systems of cosmogony and theogony of ancient nations have survived the lapse of time. The history of Chaldea, one of the most ancient of nations, appears to have been written by four different authors, but of their labours some fragments only are contained in the works of Josephus, Eusebius, and Syncellus. These fragments exhibit a most absurd and extravagant system of cosmogony, but nevertheless bear a striking coincidence with the Mosaic account of creation and the deluge.

Nearly similar to the mythology of the Egyptians was that of the Phœnicians, and from these sources sprung the theogony of the Greeks, though the traditions received by the latter were no doubt materially altered and corrupted to suit their own views. The adventures of Jupiter, Juno, Mercury, Apollo, Diana, Mars, Minerva, Venus, Bacchus, Ceres, Proserpine, Pluto, and Neptune, together with the other descendants and coadjutors of the family of the Titans, constitute the greater part of the Grecian mythology; and about the age of Moses, perhaps, these personages removed from Phœnicia to Crete, whence they found their way into Greece, which appears to have been at that period entirely in a state of barbarism. By means of the blessings of humanity and civilization which they disseminated, and the doctrines they inculcated, the highest admiration of the untutored natives was excited. In their wild enthusiasm they were led to view their benefactors as more than human; they bestowed upon them divine honours, and thus transferring to mortals that adoration which was before addressed to the luminaries of heaven, they laid the foundation of a superstructure of wild and irreconcileable fiction. But this system of mythology, already noticed in the article Greece, being familiar to every one from his early years, to enlarge upon it here were unnecessary. Under Egypt the reader will find some account of the superstitious worship of the ancient Egyptians, and the different subjects of mythology will be found described in the order of the alphabet. For more ample information on this subject, the reader may consult Bannier's *Mythology and Fables of the Ancients*, and Bryant's *Ancient Mythology.*

MYUS, one of the twelve small states into which Ionia was divided. See Ionia.

# N.

N, the thirteenth letter of the English and other modern alphabets, is a liquid consonant, of a nasal sound, pronounced invariably as in *name*, *net*; but admitting no consonant before it except *g*, *k*, and *s*, as in *gnaw*, *know*, and *snow*, nor any immediately after it in the beginning of words and syllables. In French, according to the Abbe Dangeau, it is frequently a mere nasal vowel, without anything of the consonant in it. When used as a numeral letter, N signifies 900, and with a dash over it thus, N̄, it denotes 9000. As an abreviation, N. in sea language, signifies north, and in commercial concerns N. or No. stands for *numero*. N. B. is used for *nota bene*; and among the ancient lawyers, N. L. stood for *non liquet*, *i. e.* the cause is not clear enough for decision.

NAIADES, in mythology, were certain inferior deities, usually represented as beautiful virgins, who were extremely fascinating, and who frequented the woods and meadows in the vicinity of the stream over which they were supposed to preside. They were great favourites with the country people, who sometimes sacrificed to them goats and lambs, but more frequently honoured them with offerings of milk, fruit, and flowers.

NAIRNSHIRE, a county in the north of Scotland, bounded by the Moray frith on the north, by Elgin on the east, and by Inverness on the south and west. The inland parts are mountainous, and, in general, only fit for pasturage; but towards the coast the soil is fertile, and yields excellent crops of oats and barley. It is well watered; but the only considerable rivers are the Nairn and the Findhorn, each beautifying and fertilizing a strath or valley, the one denominated Strathnairn and the other Strathrin.

In this county, about 4000 acres of land are under timber of native growth, and 6000 under plantations. Nairn contains many extensive tracts of peat, in which fir trees of considerable size have been discovered. It also abounds in sandstone; and on the property of Lord Cawdor there is a bed of pure marl of great value, and which extends over a space of 40 acres, and is in depth from 16 to 20 feet. The county is divided into four entire parishes, namely, Nairn, Ardclauch, Auldearn, and Calder, and, alternately with Cromarty, sends one member to Parliament. It likewise consists of a part of the parish of Dyke in Morayshire, of Urquhart in Ross-shire, of Croy, Moy, and Petty in Inverness-shire. The whole extent of the county is about 128,000 acres, and the population in 1811 exceeded 8000; the increase in 1821 amounted to 755. Numerous Druidical temples indicate the antiquity of Nairnshire, and the castle in the vicinity of Nairn is supposed, by Buchanan, to have been captured by the Danes in the time of Malcolm I.

*Nairn*, the county town, is a royal burgh, pleasantly situated on the river of the same name, on the Moray frith, with a convenient harbour, fifteen miles north-east from Inverness. The houses in the principal street, which runs parallel to the shore, are handsome buildings, and in the middle are situated the town-hall and gaol. On the north-west side of the hill of Geddes are the ruins of an ancient fortress called Castle-Finlay, surrounded with a deep fosse. At Easter-Geddes are the remains of a chapel, with a burying ground, where the family of Kilravoch, and the lairds of Geddes, have been interred for hundreds of years. Wool-carding and the plaiting of straw have been lately introduced into the town; but no manufacture of any extent is carried on, and the place is chiefly supported by the fisheries, by agriculture, and by the number of genteel families who either reside in it or occasionally visit it for the purpose of bathing. The population in 1811 amounted to 2500.

The fishermen, who inhabit a particular quarter of the town along the shore, and are very numerous, are accustomed to speak the Celtic language only, and do not understand English, for which reason one half of the public worship is conducted in that language. In reference to this circumstance, it is said James VI. wittily remarked to a courtier who complimented him on the surprising population of some of the great cities of England, " That none of them equalled the extent of one of the cities of his native kingdom, which was so large that one-half of the inhabitants did not understand the language of the other." Nairn received its first charter from Alexander I. which was renewed by James VI. in the year 1589.

NAISSANT, in heraldry, is applied to any animal issuing out of some ordinary, and shewing only the head, shoulders, fore-feet, and legs, with the tip of the tail, the rest of the body being hid in the shield, or in some charge upon it; in which it differs from *issuant*, which is applicable to a living creature arising out of the bottom of any ordinary or charge.

NAME, any word expressive of a person or thing, in Latin *nomen*, whence the English word *noun* is derived. Names are either *proper* or *appellative*. The latter are those terms which express common ideas, or such as comprise several individuals of the same species, as man, horse, tree, &c. The former denote some individual person or thing, so as to distinguish it from others of the same species. Proper names seem to have been originally all significative, and not simple sounds merely intended for distinction. In the earlier ages of the world and the simpler states of society, one name only was given to each person, as Adam, Busiris, Romulus, Hengist, &c. Names divinely conferred or changed, were honorary, monitory, or pledges of good, as Abraham, Jedidiah: When imposed under some supernatural impulse, they were descriptive, as John, which signifies *the mercy of God*, the name given to the harbinger of Christ; or predictive, as Methuselah, " the man at whose death shall be destruction," viz. by the flood,—Noah, " the man who shall bring consolation." In other cases, names were commemorative of some event or founded on some particular incident. We find many of them accordingly interpreted in scripture. They were sometimes taken from cattle, or what constituted the wealth of the family; thus, Rachel signifies a sheep, and among the Romans we have Porcius, Ovilius, Caprilius, Equitius, Taurus, the Fabii, &c. The most common design in devising and imposing names was to express the good wishes of the parents in a sort of benediction, or to secure respect and an honourable and good fortune by an auspicious name; hence Victor, Faustus, Probus, &c. The Abbe Barthelemi observes, that the greater number of names in Homer were given in honour of the qualities most esteemed in the heroic ages. From the word *polemos*, which signifies war, were formed Tlepolemus, and Archepolemus; and by adding the word *mache*, or battle, to certain other terms, we have Antimachus, Telemachus, Andromache, &c. We find the same respect to significancy in other nations; thus, among the Turks, Mahomet means " glorified," Soliman, " peaceable." It exists even among the negroes. " The children of the Mandingoes," says Park, " are not always named after their relations, but frequently in consequence of some remarkable occurrence. Thus, my landlord at Kamalia was called *Karfa*, a word signifying to replace, because he was born shortly after the death of one of his brothers. Other names are descriptive of good or bad qualities, as *Modi*, a good man; *Fadibba*, father of the town. Indeed," he adds, " the very names of their towns have something descriptive in them, as *Sibidooloo*, the town of Siboa trees, *Keneyeto*, " victuals here." Others appear to be given by way of reproach, as *Bammakoo*, " was a crocodile," *Karankalla*, " no cup to drink from." Among the negroes, every individual, besides his own proper name, has a kong-tong, or surname, to denote the family or clan to which he belongs."—*Travels in Africa*, p. 269.

Among the ancients, though the designation was single, it was often varied, sometimes by change of kindred letters, as *Gashmu* or *Geshem*, at other times by a different name, so Moses's father-in-law was called both Reuel and Jethro; and one of the kings of Judah was known by three names, Jehoahaz, Ahaziah, and Azariah. It became the custom of the wits and learned men, from about the middle of the 15th century, to exchange their original names for classical ones. Thus Gerard was called Desiderius Erasmus, because Gerard comes from the Dutch *gieren*, which signifies to love; and is thus of the same import with *desiderare* in Latin, and Erasmus in Greek. The predilection for Greek appears in the names, Œcolampadius, Chytrœus, Capnio, originally Reuchlin, from the word *reuch*, which signifies smoke in German, as *capnos* does in Greek, and Melancthon, originally Schwartzerd, which signifies *black earth* in German. The popes changed their names on their elevation to the pontificate, a custom first introduced by Sergius, whose name was previously Swine's-snout. The religious, assume new names on their entrance into monasteries, as a sign that they have renounced the world, their family, and all their secular hopes, and that henceforth they mean to lead a new life. Among the ancients, those who were deified were honoured with a new name at the time of their consecration, as Romulus was called Quirinus; Melisertes, Portunus or Portumnus. The name was also changed in adoptions, and sometimes by testament. So L. Æmelius, when adopted by Scipio, took the name of Scipio Africanus; and Augustus, who was at first called C. Octavius Thurinus, being adopted by the testament of Julius Cæsar, took the name of Caius Julius Cæsar Octavianus.

The ancient Britons, who painted themselves, generally took their names from colours. When they were subdued by the Romans, they adopted Roman names, some of which still remain corrupted. Those introduced by the English Saxons are still more frequent, such as Oswald, Edward, &c. The Danes too brought with them their names, Swayne, Harold, &c.; and the Normans, at the conquest, brought in others, which are still more common, as Robert, Richard, William, Henry, Hugh. Those English who were averse to foreign names, chose such as they found in the scriptures, whether of Greek or Hebrew origin, as Alexander, David, Matthew, Samuel, &c. What is now called the Christian name, is that which is imposed for the distinction of persons, answering to the Roman *prænomen*; the surname, again, is that which marks the distinction of families, corresponding to the *nomen* of the Romans, and the *patronymicum* of the Greeks. The former is styled the Christian name, because it is proclaimed at the baptism of the person; the latter being permanent, does not require to be announced. Although baptism is intended for a higher purpose than that of giving a name, yet it is proper that there should be some particular time for publicly announcing and thus confirming the name of each individual. The Romans named females on the day they were born, and males on the ninth day after birth. The Jews were accustomed to fix the name at circumcision, which took place on the eighth day. Most Christian nations have in this imitated the Jews, only the period of baptism is not universally restricted to a particular day. Surnames, both in England and Ireland, are frequently adopted from the family residence, and from rivers, towns, colours, animals, and other remarkable objects. Of this kind are Hastings, Stanhope, Hamilton, Gray, Ruth, Lyon, and many others; and among Highland clans this almost invariably takes place, particularly in the higher ranks, among females as well as males. Instances of the same kind, indeed, are to be found in almost every country, whether barbarous or civilized.

NAMUR, a province of the Netherlands, bounded partly by the French frontier, partly by the Belgic provinces of Hainault, South Brabant, and Liege. It is watered by the Meuse, the Sambre, the Lesse, and the Homme, enjoys an excellent climate, and is productive of grain, hops, tobacco, and fruit.

*Namur*, the capital, situated between two hills, at the conflux of the Sambre and the Meuse, is a handsome town, defended by a strong citadel, and adorned with a number of beautiful edifices, among which the cathedral and the church of the Jesuits are the most conspicuous. It contains extensive manufactories of fire-arms, swords, and cutlery. The population of the province is estimated at 157,000, and that of the city at 20,000.

NANCY, the capital of the department of the Meurthe in France, consists of the Old and New Town; the former irregularly built, the latter spacious and elegant. It contains the palace of the ancient dukes of Lorrain, and their tombs are in a fine saloon adjoining the church of the Cordeliers. The cathedral is a magnificent structure, and the suburbs add much to the beauty of this city, which is one of the finest in Europe. The trade is chiefly in corn and wine.

NANKIN, a city of China, capital of the province of Kiang-nan. See CHINA.

NANTES, a city of France, capital of the department of the Lower Loire, stands about 27 miles from the mouth of the Loire, on the north side of the river, which is crossed by a magnificent stone bridge, or rather succession of bridges, almost a league in length, traversing a number of islands, by which the river is there divided into six branches. There are four suburbs, which now exceed the city in extent. It had once an university, but since the Revolution this has been changed into a lyceum. The manufactures are numerous, and the trade extensive. Schools of anatomy, surgery, and hydrography,—agricultural and commercial societies,—a public library, a botanical garden, and a museum—add to the reputation of the city. It is the seat of several courts, and the see of a bishop. Population about 74,000.

NANTWICH. See CHESHIRE.

NAPTHA, a kind of petroleum or mineral oil. See GEOLOGY.

NAPIER, JOHN, baron of Merchiston, the celebrated inventor of logarithms, was born in the year 1550, and having given early indications of genius, received a liberal education from his father. After completing his studies at the university of St Andrews, he travelled in France, Italy, and Germany, and on his return declined the honours of high office in the state, to which his great reputation might have raised him, and devoted himself entirely to literary pursuits. Mathematics was his favourite study. His brilliant discovery of the logarithms, which so greatly facilitate the calculations in astronomy, navigation, and practical geometry, was first announced to the world in 1614. On this subject he corresponded with the learned Mr Briggs, at that time professor of geometry in Gresham college, London. Mr Briggs was greatly captivated with the discovery, and determined to see the inventor. Lord Buchan has quoted, from the life of Lilly the astronomer, an interesting account of the meeting which took place at Merchiston in 1616. The baron and professor regarded each other for some time in silent astonishment. Mr Briggs expressed his pleasure at the discovery of the logarithms, and was nobly entertained by the baron. He suggested an alteration of the logarithmic scale, which, though a real improvement, was not, it is alleged, greatly relished by the baron, as seeming to interfere with his own claims. It does not appear, however, that any illiberal views marred the intercourse of these illustrious men, for Mr Briggs is said to have visited Napier every summer afterwards during his life. Besides an Essay on the Apocalypse, the baron published Rabdalogia, a work containing the description and use of the apparatus called Napier's rods or bones. He died soon after on the 3d April 1617, in the 68th year of his age. His eldest son, named Archibald after his father, was constituted a privy-counsellor, and invested with other high offices by James VI. and at length raised to the peerage by Charles I. under the title of Lord Napier. See the *Account of the Life, Writings, and Inventions of John Napier of Merchiston, by the Earl of Buchan.*

NAPIER'S RODS, or BONES, certain instruments formed of bone, ivory, wood, or paste-board, which assist in performing some of the fundamental rules of arithmetic by an easy mechanical process. They are five in number; and the face of each is divided into nine equal parts, each subdivided by a diagonal line into two triangles. In the small squares the numbers of the multiplication table are inserted, the units in the right hand triangle, and the tens in the left.

For multiplication by Napier's rods, observe the following rule. Dispose the rods in such a manner, that the top figures shall exhibit the multiplicand, and to those on the left hand join the rod of units; seek there the right hand figure of the multiplier, and write out the numbers corresponding to it in the other rods, by adding the several numbers occuring in the same rhomb, and noting down their sums. Follow the same plan with the numbers corresponding to the other figures of the multiplier, disposing them under one another as in common multiplication. Then find the amount of the numbers by adding them together.

For division,—so dispose the rods that the uppermost figures may exhibit the divisor, and to those on the left join the rod of units. Then under the divisor look for those figures which give the number nearest to those of the dividend in which you wish to know how often the divisor is found; place this number under the dividend to be subtracted, and set the figure corresponding to it in the rod of units for the quotient. Thus proceed, taking down to the remainder the next figure in the dividend, then finding the number to be subtracted, and marking what corresponds to it in the units for the quotient, till the dividend is exhausted.

NAPLES, a kingdom comprising the southern part of Italy, and bounded on the north-west by the papal dominions, on the north-east by the Adriatic, and on the west and south by the Mediterranean. In form it bears a striking resemblance to the lower part of a boot; and it is one of the finest and most interesting parts of Italy. The greatest length of Naples from south-east to north-west is 300 miles, and the greatest breadth from north-east to south-west is from 96 to 120 miles. This territory consists of 15 provinces, comprehending the ancient Campania, Apulia, Magna Græcia, and Samnium; and it likewise includes a number of small islands in both the seas by which it is bounded.

Naples presents a beautifully diversified aspect, some parts being remarkable for wild and picturesque sublimity, and others for the most luxurious vegetation. From Capua to Naples, a distance of about 13 miles, the prospect is one continued grove of various kinds of trees, which produce the most delicious fruits. The whole district around the city of Naples, indeed, is extremely delightful, and is deservedly called the Campagna Felix. The azure brightness of the sky, the luxurious balminess of the air, and the fragrance of flowers and shrubs, together with the numerous splendid villas which adorn the country, all unite to inspire the traveller with the most lively sensations of pleasure. The climate is proverbially pleasant in the immediate neighbourhood of the capital, but throughout the country it is, upon the whole, rather inconstant and unfavourable to valetudinarians, being cold in the mountainous parts and exceedingly hot in the valleys and plains. It is in the months of July, August, and September that the weather is generally experienced to be most hot; and in winter there is scarcely any ice or snow except on the mountains. During some seasons incessant rains fall for six or seven weeks together; but the *sirocco* or south-east wind, which commonly occurs in May, and is very relaxing, is the most uncomfortable part of the climate.

This country is traversed from north to south by the Appenines, which branch out to the two extremities; and about five miles east from it is situated mount Vesuvius, the much celebrated volcano. (See APPENINES and VESUVIUS.) It contains many rivers, none of which is very considerable, the Volturno and Garigliano being the chief. The principal lakes are those of Celano, Agnano, Averno, Licolo, Fusaro, Lesina, and Foudi.

The soil of this delightful country is light, and in some places of a volcanic nature, but uniformly fertile, and productive of all sorts of grain, and of the finest vegetables and fruits. The fruits produced are chiefly oranges, lemons, pomegranates, citrons, dates, almonds, figs, and capers. Naples abounds in flax, hemp, cotton, saffron, manna, olive-oil, honey, and wax, together with fine wool and silk; and it likewise affords sulphur, alum, vitriol, rock-crystal, marble, and especially the Phrygian stone, or *pietra fungifera*, which has the property of yielding mushrooms, sometimes of large size, when laid in a moist and shady situation and sprinkled with warm water. Though horses formerly were an object of export here, they are now in less general use than mules, which are better adapted for the more elevated parts of the country. Great numbers of cows, oxen, and sheep are reared on the high grounds of Calabria and Ambruzzo, and great droves of buffaloes range together on the north-west coast. In the loftier parts of the Appenines the lynx or tiger cat is found. In the south of Italy the crested porcupine is very common, and the country in general is infested with reptiles and insects, some of which are of a poisonous nature. With all its natural advantages, Naples is subjected to serious inconveniencies, arising principally from earthquakes, which are frequent and alarming, and from the eruptions of Vesuvius, which not unfrequently prove destructive. Banditti who infest the mountains constitute another evil, as their depredations are but ineffectually restrained by the government.

In this part of Italy the mode of cultivating the soil is so extremely rude that the fertility of the country is to be ascribed chiefly to nature. Draining, manuring, and successive crops are but little practised. The farmer, who receives his ground stocked by the landlord, and provided with a few simple implements, (which he is bound to replace at the end of the lease,) is rewarded with only one-third of the produce. Though the vine engrosses nearly the half of the agricultural labour, the management of it is greatly inferior to that of the wine countries in France and Portugal. With the view of making as much as possible of the soil, the spaces between the rows of elms and poplars which support the vines are generally sown with grain or pulse.

Severe taxation, and insecurity of property, paralyse in this country the ingenuity and efforts, not only of the husbandman, but likewise of the merchant and manufacturer. The imports are more diversified than the exports of Naples, and consist of linen, woollen, and cotton goods, British or East Indian, groceries of various kinds, with salt fish, household furniture, hardware, clocks, and watches. Oil, silk, and wool, cotton, and wine in smaller quantities, together with *liqueurs*, and other confectionary, are the principal articles exported.

The superficial area of Naples is calculated at rather more than 30,000 acres, and the inhabitants are said to amount to about 5,000,000. Among other nations, the Neapolitans have always borne but an indifferent character. That furious jealousy for which they were once particularly noted has, in some measure, abated; but quarrels and assassinations, arising from the breach of the conjugal vow, and even from much less cogent motives, often occur, especially among the lower ranks in the metropolis. Gluttony is a predominant vice with this people; and in the female sex the passion for dress is excessive. The popish religion prevails here, and about two-thirds of the whole kingdom belong to the clergy and convents. Till of late the hereditary jurisdiction of the nobles over their vassals subsisted in the full rigour of the feudal government. On this account the peasants are in abject circumstances, and indeed it depends on the lenity of the master whether the poverty of those under his subjection be not the least painful of their miseries. Both the government and religion of Naples militate against the interests and the happiness of the people, who solace themselves amidst their grievances only with the felicity of ignorance, the gratifications of sensuality, and the pompous rites of Catholic superstition. Of the revenue and forces of Naples little is known, except that they are small.

*History.*—Naples was founded, anterior to the building of Rome, by a colony of Athenians; and when the Romans extended their conquests to Samnium, the Neapolitans became their allies, and were allowed to retain their own laws and municipal government. It fell, in after times, into the possession of the Goths, from whom Belisarius recovered it in 537; and though Totila retook it in 545, it was, not long after, again delivered by Narses. The influence of the emperor in Naples declined after Ravenna fell into the hands of the Lombards; and it appears that, in the eleventh century, the duke, or master of the soldiers at Naples, was chosen by the people. Several of the towns on the coast of Italy were, in the ninth century, taken by the Saracens, who were powerfully opposed by the Neapolitans. At length both Greeks and Saracens were overcome by the Normans, whose leaders became dukes of Apulia, Calabria, and Sicily; and Roger II. their prince, obtained the title of king of the two Sicilies in 1130. By the intrigues of the popes, the succession of Tancred's line was interrupted about the year 1166, and Naples and Sicily were held by the house of Anjou until 1504, when the French were defeated by the Spaniards, and the kingdom was annexed to the crown of Spain. In consequence of the tyranical government exercised by this nation, the celebrated revolt, headed by a poor fisherman, Tomaso Aniello, otherwise called Massaniello, took its rise. This enterprising individual strove to abolish oppression and confirm the liberty of the people, but was assassinated at the head of his own faction, in the midst of his prosperity. After the death of Massaniello, the Spaniards maintained their authority till the year 1707, when Prince Eugene took possession of the kingdom. Some years afterwards, it was, by the treaty of Rastadt, formally ceded to the emperor; but it again fell into the hands of the Spaniards in 1734. When Don Carlos succeeded to the crown of Spain in 1759, he resigned Naples to his third son Don Ferdinand, who espoused the sister of the emperor of Germany. Owing to the French revolution, Joseph, the brother of Buonaparte, was elevated to the sovereignty of the kingdom of Naples. This prince being afterwards appointed to the kingdom of Spain, was succeeded in Naples by Joachin Murat, brother-in-law to Napoleon. Murat was dethroned in 1815, when Ferdinand VII. returned, after an absence of nine years, to his capital. In 1820, Ferdinand being encompassed with many difficulties, was obliged to resign in favour of his son. With the aid of an Austrian army, however, he again recovered his throne; but the kingdom is still in an unsettled state, and garrisoned by Austrian troops.

NAPLES, the capital of the above kingdom, was originally called *Parthenope*, from the syren of that name, and afterwards *Neapolis*, or the New City, which has been contracted to Naples. It is admirably situated on a bay of the same name, and built on the slope of a range of hills fronting the south and east, and affording the most varied and delightful prospects. Including the suburbs, the circumference of Naples is upwards of eighteen Italian miles. This ancient city cannot vie with Rome in the style of architecture there prevalent, or in the number of its palaces; yet the streets are broader, and the private houses are better constructed. They are generally five or six stories high, with flat roofs, whereon are placed fruit-trees in boxes of earth or flower vases, which have a fine effect. The public edifices are of considerable magnitude, and consist principally of churches and monasteries. The cathedral, under which is situated the chapel of St Januarius, a bishop of Puzzoli,—the pretended miracle of the liquefaction of whose blood is still exhibited to the people,—is an ancient and spacious edifice, besides which the church of the Holy Apostles, the university, the royal palace, and the palaces of the nobility, are well worthy of notice. The cathedral is built on the site of two ancient temples, one of which was dedicated to Neptune and the other to Apollo. Attached to it are several chapels, all of which are remarkably rich in gilded roofs, statues of silver, &c., and some of them are adorned with the exquisite productions of Dominichino and Guido. The church of the Holy Apostles is founded on the ruins of a temple of Mercury. In a cloister of the Carthusian monastery there is a crucifix of inimitable workmanship, said to have been made by Michael Angelo. Naples contains the most rich and commodious convents in Europe, both for male and female votaries. Of the charitable foundations, the hospitals *Degli Incurabili* and *Della Annunziata* are the most considerable. Besides these, there are five hospitals of smaller note, and above thirty schools wherein poor children are boarded and educated. Several of the streets of this city are remarkably beautiful, none in Italy being comparable to the Strada di Toledo, or to those which lie open to the bay. The piazzas called Montagna, Nido, Capuana, Porto, and Porta Nova are appropriated to the nobility.

Naples.

The university of Naples, which was founded in 1224, is a magnificent edifice, though incomplete, and to it belongs a library consisting of 90,000 volumes, and a number of ancient manuscripts, and specimens of the earliest attempts at printing; likewise a cabinet of the remains found at Herculaneum, and a collection of Etruscan vases. The other literary institutions are, a royal military school, a royal naval school, and a college for the instruction of young Chinese and Japanese. There are likewise, in the city, an observatory, a botanical garden, and four public libraries.

Naples is eligibly situated for trade, which, however, is in a languishing condition. The chief manufactures are silk, fine porcelain, glass, musical instruments, snuff-boxes of tortoise shell and lava, and tables and ornamental furniture of marble. The Neapolitans are supposed to embroider in a style superior to the French, and their confections and cordials are always in great request. Most of the exports and imports of Naples pass in foreign vessels, and the trade is principally in the hands of British merchants and ship-owners. The harbour is commodious, and defended by a mole, two castles, and a few batteries. By means of a costly aqueduct, from the foot of mount Vesuvius, the city is sufficiently supplied with water.

Such has been the increase of the population of Naples, that many of the villages which, at a former period, surrounded the town are now united to it. This city was formerly divided into four parishes, but in 1719 these had increased to the number of 48, in consequence of the rapid accumulation of inhabitants. According to a late survey, the population was 330,000, of whom 155,000 were males and 175,000 females. The *lazzaroni*, or vagrants, of themselves amount to 30,000. Some of the streets of Naples are more crowded than those of London, and numbers of the poorer sort, being without lodgings, usually spend the night under porticoes, piazzas, or any other shelter they can find. Perhaps there is not a city in the world having so great a population, where such a small proportion of the inhabitants contribute to the wealth of the community, by useful and productive labour, as Naples; for, besides the almost incredible number of lazzaroni, the number of fidlers, lawyers, noblemen, and footmen, monks, and priests, is exceedingly great. The nobility, consisting of princes, dukes, marquisses, and others, are peculiarly fond of show and extravagant living, while their estates are by no means very adequate for the support of their high-sounding titles. In general, the higher ranks of the Neapolitans are characterised as dissipated, frivolous, and ignorant, and the lower as superstitious and indolent. A striking air of extravagance appears in many of the proceedings of this people; and they spend a great part of their time in the open air, and perform their cookery and many other operations in the public streets.

Among the greatest curiosities of Naples are the catacombs, which are hewn out of the solid rock, and contain an immense number of cavities on each side of the vaults, four or five over one another, into which the dead were deposited, and then shut up with a marble slab, or tile, cemented with mortar. The galleries or passages of these catacombs are loftier than those of Rome; they are mostly arched, and so wide that six persons may walk a-breast; and, in particular, there is one vault of such an amazing height that the roof cannot be discerned without the light of flambeaux.

Napoleon.

**NAPOLEON BUONAPARTE**, or **Bonaparte**, late emperor of France, and styled by some the Alexander of modern times, was born of respectable parents at Ajaccio in the island of Corsica, in 1769. During his juvenile years he discovered peculiar powers of intellect; and owing to the extraordinary endowments bestowed upon him by the hand of nature, his father, Carlo Buonaparte, who followed the profession of the law, was desirous he should rise to some distinguished rank in life. In his tenth year, he was, through the instrumentality of General Count Marbœuf, admitted an *elève du roi* into the royal military school at Brienne, which was one of the thirteen military seminaries then established in the different provinces of France. Being thus happily situated for mental improvement, he made rapid progress in his education, but devoted himself more especially to the study of mathematics, and the different branches of military science; which, together with the attentive perusal of the ancient Greek and Roman histories, and the cultivation of his little garden, constituted his main resources of occupation, pleasure, and amusement. Among his fellow scholars, he shone pre-eminent for his unexampled progress in learning; and he was not less noted for his solitary habits and singularity of manners. It is worthy of remark, that, while yet very young, he became enamoured of civil liberty, and his magnanimous spirit actuated him with an enthusiasm to command,—a striking trait in his disposition, which ultimately unfolded itself in his boundless thirst for dominion. In 1784, he quitted Brienne, and went to Paris for the further prosecution of his studies; and having thoroughly qualified himself for the military profession, he, in the following year, obtained a commission in the regiment of artillery De la Fere.

Bonaparte first brought himself into particular notice at the siege of Toulon, where he was elevated to the rank of captain; and he was next entrusted with the command of an expedition against Ajaccio owing to the island of Corsica having fallen into the hands of the British. After this unsuccessful expedition he remained for a time in obscurity, but at length obtained the command of the troops employed in 1795 against the sections of Paris. Fortune now began to smile upon him by reason of his meritorious exertions, and being ere long promoted as commander-in chief of the army in Italy, he thus had an opportunity of signalizing himself as one of the most promising generals of his time. The subsequent career of this ever memorable character, until his exilement to St Helena, is necessarily embraced in the historical details of France and of Britain in this work,—consequently, we need not here repeat the accounts already given of his amazing elevation to empire and his precipitate downfal.

Scarcely had the ex-emperor sailed from England to the place of his ultimate destination, when the attention of the British government was directed to the supply of his future wants; and, accordingly, proper arrangements were made to put him in possession of all the necessaries and comforts of life, as well as of every accommodation calculated to relieve his wounded feelings, and support his real though obscured dignity. Not long after his arrival in St Helena, Napoleon drew up a protest against the line of conduct adopted to his prejudice by the British government and their allies; and he at that period occupied himself chiefly in the compilation of his campaigns. Having acquired a tolerable knowledge of the English language, the perusal of the newspapers and different periodical works afforded him a fund of pleasure and amusement. Though evidently much depressed by the restraints imposed upon him, he bore up manfully against his melancholy reverse of fortune—cheered, unquestionably, with a ray of delusive hope, that he might yet again be restored to freedom and to empire. His mind, indeed, continued to the last deeply impressed with a sense of the majestic part he had sustained on the theatre of the world; but the remaining sparks of ambition were at length cooled and extinguished by the circumstances of his condition, together with a conviction of the rapid approach of his dissolution. He died of a cancer in the stomach in May 1821, after an illness of six weeks continuance. Till within a few hours of his paying the debt of nature, he perfectly retained his senses, and gave instructions concerning his affairs and papers. According to a desire which had been expressed by him, that his son might be made acquainted with the nature of his fatal disease, his body was opened by his own surgeon. With the full military honours paid to a general of the first rank, the remains of Napoleon were interred in a particular spot in the vicinity of Longwood, which had been fixed on by him for his place of burial.

In justice to the memory of so wonderful a man, we cannot but admire those talents, and that exquisite penetration into human nature, by which he effected his achievements, and was enabled to dazzle and confound the world with his glory. It is true, that one darling passion alone seemed to actuate the energies of his mind, and to pervade the transactions of his eventful and brilliant career; yet to treat him with indiscriminate censure on that account were preposterous, for it is undeniable, that even the most abandoned characters mentioned in history possessed at least some few qualities of a laudable nature.

Were it possible that an historian could be what Voltaire suggests, *without country or religion*, it seems desirable that a good biographer should be the same also—misrepresentation and partiality being equally unbecoming in the one and in the other. But while to the unbridled ambition of Napoleon, is traced the destruction of millions of the human race, and the overthrow of empires and kingdoms, it should be remembered that He, by whom kings reign and princes decree judgment, not unfrequently deduces harmony from apparent discord. To enter into a vindication of the character of Napoleon is by no means our purpose. We may, however, remark, that while he seemed to sacrifice to his lust of conquest the social and domestic virtues, and all that contributes to render a sovereign estimable to his subjects, he was perhaps not a little impressed and stimulated in his proceedings by a decided persuasion that the realization of his vast designs would ultimately favour the general weal, and tend to emancipate our race throughout the habitable globe from the baleful restraints of civil and religious bondage. "Take him for all in all," therefore, his character, achievements, and vicissitudes must be contemplated as the processes of one of the most instructive experiments on human nature that the hand of Providence has ever performed before the world.

NARCISSUS, in mythology, the son of Cephissus and Liriope, a youth so handsome that all the nymphs fell in love with him, but who slighted them all. Echo, among the rest, not meeting with a return of her passion, pined away till she became a mere sound. Tiresias predicted to his parents that he should never die till he saw himself. Returning one day from the chase, he stooped at a fountain to drink, and perceiving his own image, became so enamoured of himself that he languished and died, and was, by the gods, metamorphosed into the flower which bears his name. The fable is allegorical of the folly of excessive self-love.

NAREA, a province in the empire of Abyssinia. The country to the west is unknown. The eastern part, which has long since received Christianity and become subject to the emperor, is surrounded with mountains, from which numerous rivers descend. These fertilize the valleys, but render the plains marshy and unwholesome. The higher grounds produce coffee, and the whole country abounds in cattle and grain. The trade is chiefly to the west, by Angola and the continent, which stretches along the Atlantic. The medium is gold, not coined but weighed; and the chief articles of trade are coarse cotton cloths, antimony, beads, and incense. The people are brave; and though they were once vanquished and expelled from the low country by the hordes of the Galla, a powerful nation described by Mr Salt, they have latterly re-established themselves, and are now able to withstand their enemies.

NATCHEZ, the capital of the Mississippi territory in America. See MISSISSIPPI.

NATIONAL DEBT. See ECONOMY, POLITICAL.

NATOLIA, or ANTOLIA, a province of Asiatic Turkey, bounded by the Mediterranean on the south and west, by the Black sea on the north, and by Caramania on the east, and extending about 400 miles in length and 350 in breadth. It is inhabited principally by Mahometans, and it carries on a great trade in silk, cotton, leather, and drugs.

NATURAL HISTORY, in its fullest import, signifies a description of the phenomena of the universe. When we reflect on the endless variety of natural objects which present themselves to our observation, the attempt to distinguish many of them from each other appears at first sight impossible, and to enumerate the various kinds seems as unavailing an effort as that of counting the stars that bespangle the firmament, or the particles of sand on the sea-shore. By a law of the human mind, however, we arrange the objects of our investigation into particular classes; these classes are subdivided into others with additional discriminative marks, and these last are still farther subdivided till we arrive at the individual, which must, if the arrangement be correct, possess all the characteristic marks of reference to the general and subordinate divisions of that class to which it is allied. Thus, though the longest life, with the most vigorous mind, and the most unremitting industry, would prove inadequate to the task of examining every individual object, the naturalist, assisted by the observation and experience of his predecessors, can with considerable accuracy ascertain the number of kinds or species that have been discovered. By means of the lamp of science, indeed, he can detect the hidden treasures of rocks and mountains, investigate the secret wonders of the ocean, or survey all the inhabitants of the forest in their native haunts. As the province of natural history is to describe the different objects of nature with precision and accuracy, it is obvious that classification essentially aids the mind in its investigations, and facilitates the communication of knowledge.

Though there does not appear any impropriety, so far as the classification of natural bodies depends on certain fixed and rational principles, in ranking natural history among the sciences, yet this department being chiefly occupied with description and facts, is necessarily to be distinguished from natural philosophy, which implies certain physical, mathematical, and theoretical reasonings that do not belong to the former. Natural history is evidently related very closely to particular sciences or branches of knowledge, affording them, or deriving from them assistance and illustration. Thus, an intimate acquaintance with anatomy and physiology prepares us to understand thoroughly the peculiar nature and properties of animals and vegetables;—a knowledge of the principles of chemistry qualifies us to ascertain the nature and qualities, as well as the multifarious changes of the bodies in the material world; and particular branches of natural philosophy serve to illustrate the phenomena of the atmosphere, and the properties of water. Geography and natural history, also, are mutually beneficial; the former affording a knowledge of the particular situations of natural objects, while the details of the latter tend to enliven those of geographical description.

Leaving to the astronomer the study of the celestial phenomena, the objects which present themselves to the eye on our globe constitute the empire of nature, which has been, with apparent propriety, divided into the animal, the vegetable, and the mineral kingdoms. But although this division has, by many writers on natural history, been considered as altogether unobjectionable, the objects of nature, how different soever in texture, form, and motion, may be more consistently ranged into two grand divisions, namely, inorganic and organized bodies. The notion of a regular *chain of being*, by which minerals form a connecting link with vegetables, these with animals, &c. is now justly exploded as the theoretical offspring of imagination. See Dr Fleming's *Philosophy of Zoology*.

Without entering into detail, our present purpose is merely to notice the two grand divisions into which the objects of natural history range themselves, referring the reader for information respecting the classes, orders, genera, and species, to the respective articles under which they are discussed.

*Inorganic bodies* are arranged under three divisions, which accord with the ancient distribution of inanimate bodies into air, earth, and water. The natural history of the atmosphere, which is generally studied in connection with the truths of natural philosophy, has been discussed under the article METEOROLOGY; that of the waters and of the earth under GEOLOGY, which includes *Hydrography* as well as *Mineralogy*. See also COALIERY and GEOGRAPHY.

*Organized bodies* consist of two great divisions, animals and vegetables, which are distinguished from each other by their structure and composition, their particular functions, and the degree of vitality which they possess. Intimately connected with the former of these divisions are the articles ANATOMY *human* and *comparative*, CONCHOLOGY, ENTOMOLOGY, ERPETOLOGY, ICHTHYOLOGY, HELMINTHOLOGY, MAMMALIA, OPHIOLOGY, and ORNITHOLOGY. The other branch of the second general division of natural history constitutes the study of BOTANY, besides which, see AGRICULTURE and GARDENING.

Regarding this highly important department of human knowledge, which ought assuredly to hold a place in every system of education, it is generally admitted that the eye more than the ear is the medium of obtaining information. Hence appears the great utility of collections of natural objects, denominated museums. In a mineralogical museum should be collected specimens of simple minerals, of rocks, and of petrefactions systematically arranged. The botanic garden, by presenting the natural productions of different countries and climates in life and beauty, and the herbarium, by presenting its vegetable stores in a dried state, stimulate to, and facilitate the interesting study of botany. By contemplating the various animals brought together in the menagerie from all quarters of the globe, the student becomes acquainted with their forms, motions, and instincts; and collections of various animals, such as insects, birds, and quadrupeds, preserved in a dried state, are likewise eminently calculated to promote the study of natural history. But, in addition to all these powerful aids, the student of nature, in order to prosecute his researches successfully, must engage himself in the field of actual observation. He must investigate the characters of the different creatures in their peculiar conditions, and trace their changes when beyond the sphere of human influence.

NATURAL PHILOSOPHY, or PHYSICS, is that science which treats of the action of natural bodies upon one another, when that action is not accompanied with any lasting change in their internal condition. The laws of nature are certain axioms or general rules of motion and rest observed by natural bodies in their actions upon one another; and of these laws, three have been established by the illustrious Newton. They are elucidated under the article MECHANICS.

On this branch of knowledge, which Lord Bacon denominates the great mother of the sciences, Dr Robison makes the following excellent remarks: "The operations of nature are seldom at rest. Change succeeds change, new combinations are formed, and new productions make their appearance. The primary planets revolve round the sun as their centre; the secondary planets, or the moons attracted by the primary, perform similar revolutions; the air of the atmosphere presses on the surface of the earth with a certain force; a stone when unsupported falls to the earth in a course directed towards its centre; water deprived of a certain portion of heat becomes solid, and appears in the form of ice; when combined with a greater proportion of heat than what is necessary to retain it in the fluid state, it assumes the form of vapour, ascends into the atmosphere, is there, by certain processes, robbed of its heat, and reappears in the form of rain: or, when a greater portion is abstracted, takes that of snow or hail, and falls to the earth. A seed is put into the ground, and, if heat, air, and moisture be applied, it germinates, and springs up, and, with the addition of light, if the operation of the same agents be continued, it becomes a new plant, puts forth leaves and flowers, and produces seeds similar to that from which it sprung. Now, to determine what are these changes, to observe the laws by which these changes are effected, and to ascertain the measure and quantity of the effect produced, belongs to that department of knowledge which is included under the general term natural philosophy, or physics. But of these changes or motions, some are obvious and palpable, others entirely elude our senses. We see a stone descend to the earth, and experience informs us that it falls with a force in a certain proportion to its weight and the height from which it fell. The peculiar change or motion which takes place when water assumes the solid form, when a fluid undergoes the process of fermentation, or when a combustible body is burnt, is altogether imperceptible. These motions are too minute to be recognized. The effect is produced before we can ascertain the cause. Thus natural philosophy divides itself into two great branches. The objects of the first are the sensible changes or motions which are observed in the material world, and the consideration of these objects is properly natural philosophy or physics; the second great branch which is employed in discovering the laws, and appreciating the effects of the insensible motions of bodies, constitutes the science of chemistry."

The following articles in this work are intimately connected with natural philosophy: ACOUSTICS, AEROSTATION, ASTRONOMY, ELECTRICITY, including *Galvanism*, MAGNETISM, MECHANICS, METEOROLOGY, OPTICS, and PNEUMATICS.

NATURALIZATION, in law, is the making an alien the king's natural subject, and thus putting him in the same condition as if he had been born in the king's ligeance, with this exception, that he is incapable of becoming a member of the privy council, or parliament, or of holding any office or grant. A naturalized individual may possess lands by descent, as heir at law, and he may also obtain them by purchase. None can be naturalized in England but by act of parliament; and, within one month before the bringing in of the bill, the person must have received the sacrament, and taken the oaths of allegiance and supremacy in the presence of the parliament. See ALIEN.

NAVAL ARCHITECTURE. See SHIP-BUILDING.

NAVAL TACTICS. See WAR.

NAVARRE, a province of Spain, bounded on the north by the Pyrenees, on the south and east by Arragon, and on the west by Biscay and Old Castile, and extending about 80 miles from south to north, and 75 from east to west. It is productive of grain, wine, and oil, and abounds in sheep and cattle, as well as wild fowl. Prior to the Revolution, this province contained two bishoprics, two cathedral chapters, five collegiate chapters, 753 parishes, 70 religious houses, 12 hospitals, and two asylums. In the neighbourhood of Pampeluna, which is the chief town, a copper mine is situated, and, near Valtierra there is a mine of rock salt. Several distilleries for brandy are established in Navarre, besides manufactories of cloth, soap, pottery, and a royal manufactory for cast-iron, bombs, and balls.

NAVE, a term derived from the Greek, and applied to the body of a church where the people are disposed, reaching from the balluster or rail of the door to the chief choir.

# NAVIGATION.

History. History.

Navigation is that art by which the course of a ship is directed on the surface of the waters. From the number and complexity of those principles upon which it depends, many ages must have elapsed before it could arrive at any degree of perfection. The rude and unfinished state in which it is still found among barbarous nations, corresponds with this opinion, and shows that it results from the combined efforts of many successive generations. For a considerable period after the nations of antiquity began to cultivate navigation, they were for the most part completely ignorant of those great truths which at this time constitute its primary elements. The structure of their vessels was clumsy, and their manner of working them extremely defective; they were mostly without decks, having only one mast, which was erected or taken down at pleasure. Ignorant of the use of anchors, they had no other means of securing their barks, than by drawing them ashore as savages do their canoes, where they remained upon dry land until the season approached for again returning to sea. Even in the mildest climates, it was only during the summer months, and under the clearest atmosphere, that they durst venture from the shore. It would have been deemed most inconsiderate rashness to have braved the fury of the winds and waves in winter when the skies were covered with clouds, as they had no other means of directing their course than by turning their observations to the stars, in a manner which was both fallacious and inaccurate. Of consequence, the attempts they made in navigation, under such circumstances, were timid and uncertain; they durst seldom lose sight of land, but crept along the coast, exposed to all the difficulties and dangers, and retarded by all the obstructions of such awkward and circuitous passages. Fortunately, however, a discovery was made that soon enabled mariners to remedy these inconveniences, which contributed more to the advancement of navigation than all the efforts and ingenuity of preceding ages. When that amazing property which the magnet possesses of turning towards the poles of the earth was discovered, mankind immediately perceived the advantages that might be derived from it in directing navigation. With this view that invaluable instrument called the mariners' compass was constructed, and by its assistance navigators found, that in every place and in all seasons of the year, they could discover the north and south, with so much ease and accuracy, that it no longer became necessary for them to depend upon the appearance of the stars or a view of the sea-coast. Accordingly, they gradually abandoned their ancient timid and lingering course, ventured boldly into the ocean, and, relying with confidence on this faithful monitor, explored their way in the darkest night, and under the most cloudy sky. The compass may be said to have rendered to man the dominion of the sea, by enabling him to make that vast element subservient to his wishes, which, by its formidable appearance, was long considered as the bounds of the habitable globe. Many disputes have arisen concerning the origin of this great discovery, but these, far from elucidating, have only involved it in greater obscurity. It has often been the fate of those illustrious benefactors of mankind, who have enriched science and improved the arts by their inventions, to derive more reputation than benefit from the happy efforts of their genius. But the fate of him to whom society is indebted for this inestimable treasure has been still more unfortunate. Either through the inattention or ignorance of cotemporary historians, he has been defrauded even of that fame to which he was so justly entitled. All the researches and conjectures of modern writers amount to no more than a probability, that the mariner's compass was either invented or revived by Flavio Gioio, a citizen of Amalfi in the kingdom of Naples, who lived about the beginning of the fourteenth century; but every particular relative to his profession, or the precise time when he made this discovery, is completely unknown,—leaving scarcely intelligence sufficient to satisfy curiosity concerning the origin of that event which has been productive of greater effects than any recorded in the annals of history. Encouraged by the unusual success and expedition which attended the use of the compass in navigation, mariners began rapidly to improve in that art, and to open to themselves a more ample field for the display of their talents and enterprise. Geography, mathematics, and astronomy, the sciences upon which it is founded, became objects of studious attention. From them the nations of Europe imbibed as much knowledge as emboldened them to disregard the prejudices and correct the errors of their ancestors. Ignorance and superstition, the constant enemies of every rational pursuit, were by these means gradually dispelled.—The light of science arose, and the human mind, disentangled from scholastic dogmas, began to expand and grasp at more arduous undertakings. Various improvements were accordingly made in navigation, squadrons were fitted out, and voyages projected by different nations, for the purpose of exploring those regions which remained concealed from the knowledge of mankind. When European navigators, however, began to stretch their hazardous voyages over the deep, and to visit oceans that had never been traversed before, they found that the compass was destitute of that steadiness which it was formerly supposed to possess. The celebrated Columbus is said, by his son, to have been the first who remarked this variation during that voyage in which he discovered America, although by others it has been attributed to Sebastian Cabat. Whoever may have been the first that observed it, the fact is certainly correct, as subsequent observations have proved, although the real cause of the phenomenon still remains to be one of those mysteries of nature into which the sagacity of man has not yet been able to penetrate. But as these progressive improvements that were made in navigation will be fully traced in the preliminary dissertation, the instruments used in it will also be described under their respective denominations. We shall, therefore, proceed to lay before the reader a concise view of the different sailings that are requisite in conducting a ship from one port to another.

*Plain-sailing* is founded upon the supposition, that the earth is an extended plane, that the meridians are parallel, and that the parallels of latitude are at equal distances from each other. Though these principles continued are evidently erroneous, still, in a short run, particularly near the equator, an account of the ship's way may be kept with considerable accuracy. In doing this, it is necessary to take into consideration the course, distance, difference of latitude, and the departure.

The course is the angle which the ship's track makes with the meridian, and it may either be expressed in degrees or in points of the compass.

The distance is the number of miles between any two places reckoned on a rumb line of the course, or it is the way a ship has gone on a direct course for a given time.

The difference of latitude is the distance a ship has gone north or south of the place from which she departed.

The departure is the distance which a ship has gone east or west from the meridian of the place from which she departed.

Thus, let A denote a certain point on the earth's surface (Fig. 1. Plate for Navigation,) AC its meridian, and AD the parallel of latitude passing through it; suppose a ship to sail from A on the N. N. E. rumb till she arrives at B, through B draw the meridian B D, which, according to the principles of plain-sailing must be parallel to AC, draw also the parallel B C; then the angle C A B will be the course, the length of AB, that is, how far the ship has sailed upon the N. N. E. rumb, is called her distance; A C or B D will be her difference of latitudes, and C B will be her departure. Hence, it is plain, that the distance sailed will always be greater than either the difference of latitude or departure, it being the hypothenuse of a right-angled triangle, of which the other two are the sides, unless the ship sails either on a meridian or a parallel of latitude; for if the ship sails on a meridian, then it is plain that her distance will be just equal to her difference of latitude, and she will have no departure; but if she sails on a parallel, then her distance will be the same with her departure, and she will have no difference of latitude. It is clear also, that if the course be less than four points or 45 degrees, its compliment, the other oblique angle will be greater, and so the difference of latitude will be greater than the departure; but if the course be greater than four points, the difference of latitude will be less than the departure; and, lastly, if the course be just four points, then the difference of latitude will be equal to the departure.

Since the distance, difference of latitude, and departure, form a right-angled triangle, in which the angle opposite the departure is the course and the other its complement,—therefore, having any two of these given, we can find the others; hence arise the different cases of plain sailing, which are as follow:

*Case* 1.—Given the course and distance, to find the difference of latitude and departure.

*Example.*—A ship from latitude 47° 30′ N. has sailed S. W. by S. 98 miles: What latitude is she in, and what departure has she made?

*Geometrical Construction.*—Draw Fig. 2. the meridian AD, make the angle A equal to three points of the compass, and A B equal to 98 miles, from B let fall the perpendicular B D, then A D will represent the difference of latitude, and B D the departure.

To find these by calculation, the course three points being equal to 33° 45′.

To find A D, the difference of latitude.

As rad. . . . 90° . 10.00000
Is to dis. . . . 98 m. . 1.99123
So. is cos. co. . . 33° 45′ . 9.91985

To A D diff. of lat. . 81 . 48 . 1.91108

To find B D the departure, the camp of the course five points being equal to 56° 15′.

As rad. 90 . . . 10.00000
Is to A B. dist. 98 m. . . 1.99123
So. is sine co. 33° 45′ . . 9.74474

To B D departure 54.45 . . 1.73597

*Case* 2.—Given the course and difference of latitude, to find the distance and departure.

*Example.*—A ship in latitude 45° 25′ north, sails N. E. by N., one-half easterly, till she come to latitude 46° 55′ north: Required the distance and departure made good upon that course.

Since both latitudes are northerly, and the course also northerly—Therefore,

From the latitude come to . . . 46° 55′
Substract the latitude, sailed from 45° 25′

And there remains . . . . . . 1° 30′

Or the difference of latitude, equal to 90 miles.

*Geometrical Construction.*—Let A D, Fig. 3. equal to 90 miles, represent the meridian of the place from which the ship sails,—from A, draw A B, making the angle B A D equal to 39° 22′, the number of degrees and minutes corresponding to the points of the compass which are given, and from B let fall the perpendicular B D, then A B will represent the distance, and B D the departure, which are required to be found.

Calculation—To find the departure B D.

As radius . . . . . . . . . . 10·00000
Is to dif. of latitude A B 90 . . . 1.95424
So is the tangent of course A 39° 22′ 9.91404

To the departure B D = 73° 84′ 1·86828

To find the distance A B.

As radius . . . . . . . . . . 10.00000
Is to the secant of the course 39° 22′ 10.11176
So is the difference of lat. A D 90 1.95424

To the distance A B . . 116.4 2.06600

*Case* 3.—Given the course and departure, to find the distance and difference of latitude.

*Example.*—A ship from latitude 47° 30′ north, sailing N. W. by W. finds she has made 82 miles of departure: What distance has she run, and what latitude is she now in?

*Geometrical Construction.*—Let A D, Fig. 4. represent the meridian of the place from which the ship sails, draw A B making an angle D A B equal to 56° 15′, the degrees and minutes corresponding to the given number of points of the compass, and produce it untill it meets *b* B, a line parallel to A D, at the distance *b* A, 82 miles from it,—then from B draw B D parallel to *b* A and A B, A D will be the distance run and difference of latitude.

Calculation.—To find the distance A B.

As sine course 56° 15′ . . . . . 0·08015
Is to the departure 82 miles . . . 1·91381
So is radius 90° . . . . . . . . 10·00000

To distance A B 98·62 . . . . . . 1·99396

To find the difference of latitude.

As sine course 56° 15′ . . . . . 0·08015
Is to the departure 82 miles . . . 1·91381
So is cos. course 56° 15′ . . . . . 9·74474

To difference of latitude 54° 79′ . . 1·73870
Then, since the lat. sailed from was 47° 30′ N.
And the difference of latitude . . . 0° 55′ N.

The latitude she is now in will be . 48° 25′ N.

*Case* 4.—Given the difference of latitude and departure, to find the course and distance.

*Example.*—A ship sails from latitude 44° 50′ north, between south and east, till she has made 64 miles of departure, and is then found by observation to be in latitude 42° 56′ north, Required the course and distance.

Since the latitudes are both north, and the ship sailing towards the equator, therefore, from the latitude sailed from, . . . . . . . . 44° 50′ N.
Take the latitude come to, . . . . 42° 56′ N.

And there remains . . . . . . . 1° 54′
Equal to 114 mile, the difference of latitude.

*Geometrical Construction.*—From G draw the meridian G K, (Fig. 5) and make it equal to 114 miles; and from K draw K L perpendicular to K G, and equal to 64; join K L, then the angle G and line G L will be the course and distance required.

Calculation.—To find the course K G L.

As the difference of latitude G K 114 2·05690
Is to radius . . . . . . . . . . 10·00000
So is the departure . . . . 64 1·80618

To the tangent of course G 29° 19′ . 9·74928

To find the distance G L.

As radius . . . . . . . . . . 10·00000
Is to the difference of latitude G K 114 2·05990
So is the secant of the course 29° 19′ 10.05952

To the distance G L . . 130·8 . 2·11642

Consequently the ship has sailed on a S.S.E.½ east course 130·8 miles.

*Case* 5.—Given the distance and difference of latitude, to find the course and departure.

*Example.*—A ship from latitude 47° 20′ north, sails between the north and east 98 miles, and arrives at latitude 48° 42′ north, what course did she steer, and what departure has she made?

*Geometrical Construction.*—Take A D, Fig. 6. a part of the meridian equal to 82 miles; from D draw D B perpendicular to A D, and with the centre A and radius A B, 98 miles, describe a circle cutting D B in B, D A B will be the course the ship steered, and D B will be her departure.

Calculation.—To find the course D A B.

As the distance A B, 98 miles . . . 8·00877
Is to radius . . . . . . . . . 10·00000
So is the difference of latitude A D, 82 miles . . . . . . . . . 1·91381

To cos. of the course 33° 13′ . . . 9·92258

To find the departure D B.

As radius . . . . . . . . . . 10·00000
Is to the distance A B 98 miles . . 1·99123
So is the sine of course D A B 33° 13′ 9·73863

To the departure D B 53° 69′ . . . 1.72986

*Case* 6.—Given the distance and departure, to find the course and difference of latitude.

*Example.*—A ship sails from latitude 34° 24′ north, between north and west 124 miles, and is found to have made 86 miles of departure, What course did she steer, and what is her difference of latitude?

*Geometrical Construction.*—Draw A B equal 86 miles, (Fig. 7.) and from B, B D perpendicular to it; with the centre A and radius A D describe a circle cutting B D in D; then A D B will be her course, and D B the difference of latitude.

Calculation.—To find the course A D B.

As the distance A D 124 miles . . 2.09342
Is to radius . . . . . . . . . 10.00000
So is the departure A B 86 miles . 1.93450

To the sine of the course D 43° 54′ 9.84108

To find D B the difference of latitude.

As radius . . . . . . . . . . 10.00000
Is to the distance A D 124 miles . 2.09342
So is the cosine of the coursse 43° 54′ 9.85766

To B D the difference of latitude 89.35 1.95108

*Traverse Sailing.*—When a ship runs several courses in twenty-four hours, the reducing of all these into one, and by that means finding the course and distance made good upon the whole, is commonly called the resolving of a traverse.

At sea, they usually begin each day's reckoning from the noon of that day, and from that time they set down all the different courses and distances run by the ship till noon next day, upon the log-board; then from these several courses and distances had from the compass and log-line, they compute the difference of latitude and departure from each course; and these, together with the courses and distances, are set down in a table called the traverse table, which consists of five columns; in the first of which are placed the courses and distances, in the two next the differences of latitude belonging to these courses, according as they are north or south, and in the two last are placed the departure belonging to these courses according as they are east or west. Then they sum up all the northings

# NAVIGATION

## PLATE 137.

Fig. 1.

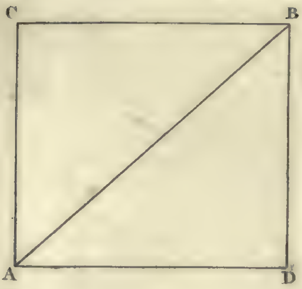


Fig. 2.

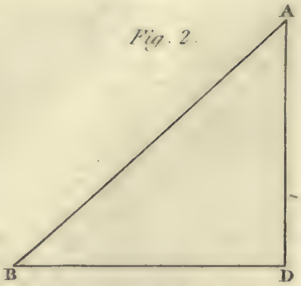


Fig. 3.

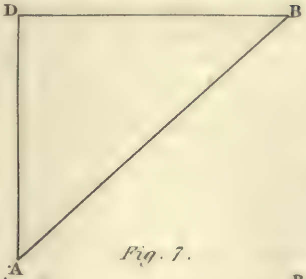


Fig. 4.

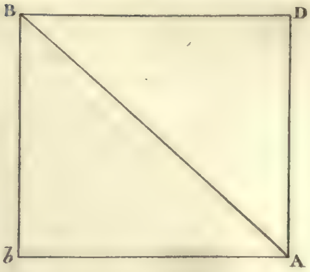


Fig. 5.

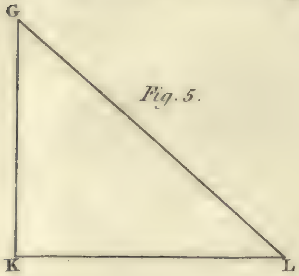


Fig. 9.

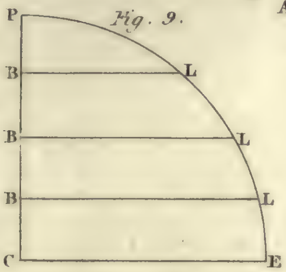


Fig. 7.

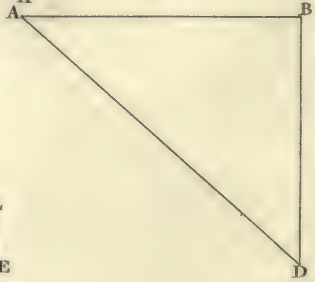


Fig. 8.

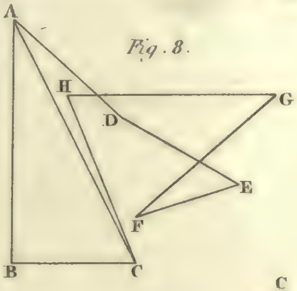


Fig. 6.

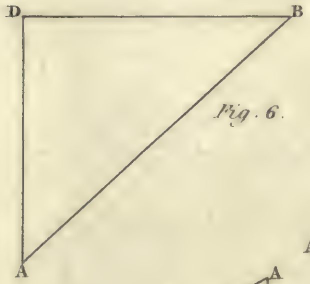


Fig. 10.

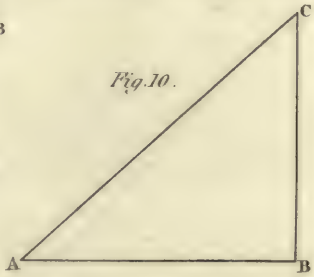


Fig. 11.

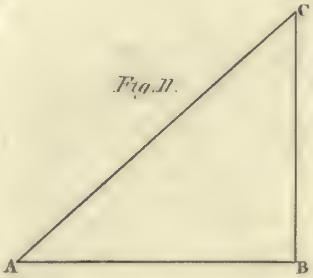


Fig. 12.

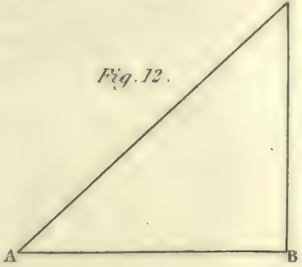


Fig. 13.

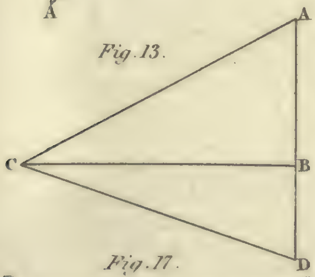


Fig. 14.

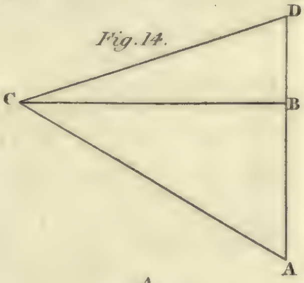


Fig. 15.

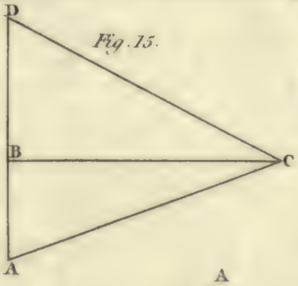


Fig. 16.

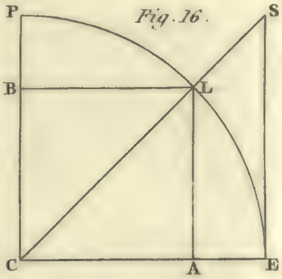


Fig. 17.

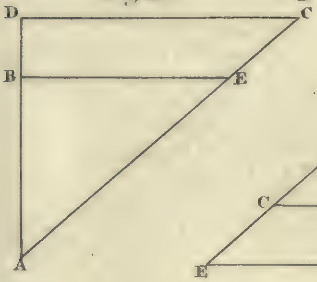


Fig. 18.

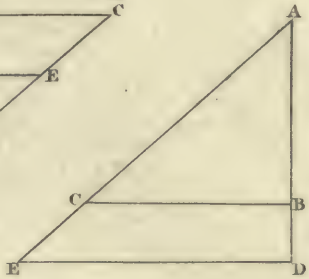


Fig. 19.

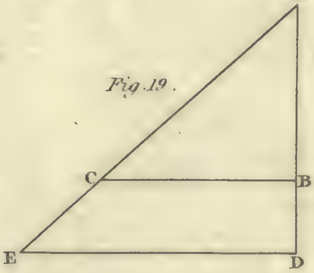


Fig. 20.

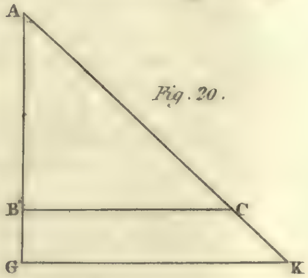


Fig. 21.

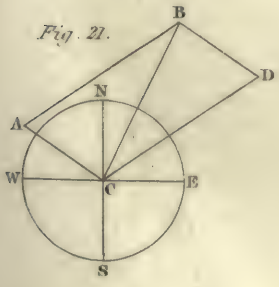


Fig. 22.

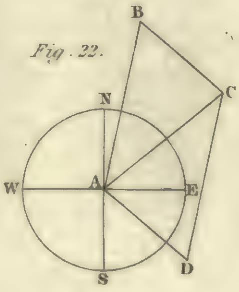
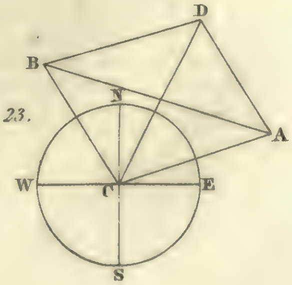


Fig. 23.



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and all the southings; and, taking the difference of these, they know the difference of latitude made good by the ship in the last twenty-four hours, which will be north or south according as the sum of the northings or southings are greatest. The same way, by taking the sum of all the eastings, and likewise of all the westings, and subtracting the lesser of these from the greater, the difference will be the departure made good by the ship the last twenty-four hours, which will be east or west according as the sum of the eastings is greater or less than the sum of the westings; then, from the difference of latitude and departure made good by the ship last twenty-four hours, found as above, they find the true course and distances made good upon the whole, also the course and distance to the intended part.

*Example.*—A ship from latitude 39° 30′ north, meeting with contrary winds, sailed S. E. by S. 67 miles, S. E. by E. 53 miles, W. S. W. 45 miles, N. E. by N. 74 miles, W. 57 miles, and S. by E. 83 miles: Required her difference of latitude, departure, course, and distance from the place she sailed from, and the latitude come to? (Fig. 8.)

| Courses. | Dest. | N. | S. | E. | W. |
|---|---|---|---|---|---|
| S. E. by S. | 67 | | 55.7 | 37.2 | |
| S. E. by E. | 53 | | 29.4 | 44.1 | |
| W. S. W. | 45 | | 17.2 | | 41.6 |
| N. E. by N. | 74 | 61.5 | | 41.1 | |
| W. | 57 | | | | 57. |
| S. by E. | 83 | | 81.4 | 16.2 | |
| | | 61.5 | 183.7 | 138.6 | 98.6 |
| | | | 61.5 | 98.6 | |
| | | | 122.2 | 40.0 | |

By these different courses, the ship has got 122.2 miles to the south, and 40 miles to the east of the place sailed from. Hence the course is 18° 7′ south-eastward, and the distance 128.6 miles. The latitude come to is 37° 28′ north.

*Parallel Sailing* is a method for finding what distance a ship should run due east or west in sailing from the meridian of one place to that of another, in any parallel of latitude.

This kind of sailing is particularly useful in conducting a ship to an island detached from the mainland, or from other islands; in which case, it is usual to run into the latitude of the island, and then to steer due east or west, uutil the ship comes to the longitude of the given place.

The principles upon which it depends, may be thus illustrated.

Let E P represent a quadrant of the meridian, Fig. 9. E a point on the equator, P the pale, and C the centre of the earth, and L any point on the meridian between the equator and the pole whose latitude is L E, and its compliment L P. Draw L B parallel to C E; then, if the quadrant C P E revolve round the axis C P, the point E will describe the equator, and the point L a parallel of latitude. These circles are to each other in the proportion of their radii C E and B L. But wholes are as their similar parts; therefore, any part of the equator is to a similar part of the parallel of latitude described by the point L, as C P is to B L; that is, as radius is to the cosine of the latitude. Hence, as radius is to the cosine of any latitude, so is the difference of longitude, or the distance of the two meridians on the equator, to their distance on the parallel of latitude.

*Case* 1.—Given the difference of longitude between two places both lying on the same parallel: To find the distance between those places.

*Example.*—A ship in latitude 54° 20′ north, sails directly west on that parallel till she has differed her longitude 12° 45′, What distance has she sailed on that parallel?

*Geometrical Construction.*—Draw A B any length, Fig. 10. make the angle B A C equal to the latitude 54° 20′, from A to C lay off the difference of longitude 765, and from C let fall the perpendicular, C B then will be the difference required. To find which,

As radius . . . . . . . . . 10.00000
Is to the casine of the latitude 54° 20′ 9.76572
So is the difference of longitude 765 2.88366

To the distance on the parallel 446.1 2.64938

*Case* 2.—Given the distence between two places both in the same parallel of latitude: To find their difference of longitude.

*Example.*—A ship from latitude 49° 32′ north, and longitude 10° 16′ west, sails due west 118 miles: What is her present longitude.

*Geometrical Construction.*—Draw the line A B, Fig. 11. and make it equal to 118, the given distance; make also the angle B A C equal to the latitude 49° 32′; upon B A, erect the perpendicular B C, cutting A C in C, then will A C be the difference of longitude.

Calculation.

As the cos. of the latitude 49° 32′ . . . 9.81225
Is to the distance A B 118 . . . . . 2.07188
So is radius . . . . . . . . . . 10.00000

To the difference of longitude 181.8 . . 2.25963
Then the longitude left . . . . . . 10° 16′ W.
Added to the difference of lon. 182. or 3° 2′ W.

Gives the longitude that the ship is in, 13° 18′ W.

*Case* 3.—Given the difference of longitude, and its corresponding meridional distance: To find the parallel of latitude.

*Example.*—In what latitude does 384 miles of meridianal distance answer to 500 miles of difference of longitude?

*Geometrical Construction.*—Draw the line A B, Fig. 12. and make it equal to the distance 384; on B erect the perpendicular B C and with an extent in the compasses equal to the difference of longitude 500, set one foot in A, and with the other cut B C in C, and draw the line A C: Then the angle C A B will be the latitude required.

*Calculation.*

| | | |
|---|---|---|
| As the difference of long. A C | 500 | 7·30103 |
| Is to A B the distance . . . | 384 | 2.58433 |
| So is radius . . . . . . . . . | | 10·00000 |
| To B A C the cos. of the lat. | 39° 49′ | 9·88536 |

So that in latitude 39° 49′, 384 miles of meridianal distance answers to 500 miles of longitude.

*Middle latitude sailing.*—Since the distance of any two meridians varies with the latitude, when a ship sails any distance on an oblique rumb, and thereby gets into a different latitude, what is called her departure, in plain sailing, is not the distance between the meridian of the place sailed from and the meridian of the ship in present latitude. To correct this error, the distance of the two meridians in the middle parallel between the latitude sailed from and that come to, is taken from the true departure; and hence this correction is called middle latitude sailing; which although not perfectly accurate, answers pretty well for keeping an account of the ship's difference of longitude in small distances, such as one day's sailing.

*Case* 1.—Given the latitudes and longitudes of two places, to find the course and distance between them.

*Example.*—Required the direct course and distance between the Lizard, in latitude 50° north, and longitude 5° 14′ west, and St Vincent, in latitude 17° 10′ north, and longitude 24° 20′ west.

| | |
|---|---|
| First to the latitude of the Lizard | 50° 00′ N. |
| Add the latitude of St Vincent . | 17° 10′ N. |
| The sum is . . . . . . . . . . | 67° 10′ N. |
| Half the sum, or latitude of the middle parallel, is . . . . . . . | 33° 35′ N. |
| Also the difference of latitude is . | 32° 50′ |
| Equal to 1970 miles of southing. | |
| Again, from the long. of St Vincent | 24° 20′ W. |
| Take the longitude of the Lizard . | 5° 14′ W. |
| And there remains . . . . . . | 19° 6′ W. |

Equal to 1146 miles of difference of longitude west.

*Geometrical Construction.*—Draw the line A D to represent the meridian of the Lizard, (Fig. 13.) make the angle A D C equal to the co. mid. lat. 56° 25′, and from D to C lay off the difference of longitude 1146; from C draw the line C B perpendicular to A D, make B A equal to the difference of latitude 1970, and draw the line A C,—then will B C be the departure, the angle B A C the course, and A C the distance.

To find the departure.

| | | |
|---|---|---|
| As radius . . . . . . . . . . | | 10·00000 |
| Is to the cos. mid. lat. . . . | 33° 35′ | 9·92069 |
| So is diff. of longitude . . . . | 1146 | 3·05918 |
| To the departure . . . . | 954·7 | 2·97987 |

To find the course.

| | | |
|---|---|---|
| As the difference of latitude · | 1970 | 3·20447 |
| Is to radius . . . . . . . . . | | 10·00000 |
| So is the departure · . . . . | 954·7 | 2 97987 |
| To the tang. of the course . | 25° 51′ | 9·68540 |

To find the distance.

| | | |
|---|---|---|
| As radius . . . . . . . . . . . | | 10·00000 |
| Is to the diff. of lat. . . . . | 1970 | 3·29447 |
| So is sec. of the course . . | 25° 51′ | 10·04579 |
| To the distance . . . . . . | 2189 | 3·34026 |

Hence St Vincent is 2189 miles S.S.W. ¼ W. from Lizard.

*Case* 2.—Given the latitude, course, and distance, to find the difference both of latitude and longitude.

*Example.*—A ship takes her departure from a place in latitude 51° 18′ N., longitude 9° 50′ W., and steers south 33° 8′ W. till she has run 1024 miles: What is her present latitude and longitude?

*Geometrical Construction.*—Draw A D, (Fig. 14.) and make the angle D A C equal to the course 33° 8′; lay off from A to C the distance, 1024 miles, and draw the line C B perpendicular to A D; then will C B be the departure, and A B the difference of latitude. From C draw C D, making the angle B C D equal to 44° 9′ middle latitude,—then will C D be the difference of longitude.

Calculation.—To find the diff. of latitude.

| | | |
|---|---|---|
| As radius . . . . . . . . . . | | 10·00000 |
| Is to the distance . . . . . | 1024 | 3·01030 |
| So is cos. of the course . . | 33° 8′ | 9·92293 |
| To the difference of latitude . | 857·5 | 2·93323 |
| Now, from latitude . . . . . . | 51° 18′ N. | |
| Take diff. of latitude 857, . . . | 14° 17′ S. | |
| And there remain pres. latitude . | 37° 1′ N. | |
| To this add the lat. departed from, | 51° 18′ | |
| and the sum is . . . . . . . | 88° 19 | |
| Half the sum or middle latitude is . | 44° 9′ | |
| Complement of the middle latitude is | 45° 51′ | |

To find difference of longitude.

| | | |
|---|---|---|
| As cos. middle latitude . . | 44° 9′ | 0·14417 |
| Is to the tangent of the course | 33° 8′ | 9 81473 |
| So is the difference of latitude | 857·5 | 2·93323 |
| To the difference of longitude | 780·1 | 2·89213 |

| | |
|---|---|
| To longitude departed from . . | 9° 50′ W. |
| Add 780, the difference of longitude, or its equal . . . . . . . . . | 13° 0′ W. |
| And we shall have the present longitude . . . . . . . . . . | 22° 50′ W. |

*Case* 3.—Given the latitudes and course between two places, to find their distance and difference of longitude.

*Example.*—A ship from latitude 42° 25′ N. and longitude 15° 6′ W., sails N. E. by E. for several days, and then finds by observation that she is in latitude 46° 20′ N.: What distance has she sailed, and what is her present longitude?

| | |
|---|---|
| The latitude left is . . . . . . . | 42° 25′ N. |
| Latitude arrived at . . . . . . . | 46° 20′ N. |
| Difference of latitude . . . . . | 3 55 |
| The sum of the latitudes is . . . | 88 45 |
| And the half sum or mid. lat. is . | 44 22 |

*Geometrical Construction.*—Draw the line A D, (Pl. 137. Fig. 15.) and from it lay off A B equal to the difference of latitude 235 miles; from B erect the perpendicular B C, and make the angle B A C equal to the course 5 points; draw C D, making the angle B C D equal to the middle latitude 44° 22′,—then A C will be the distance the ship has sailed, and D C the difference of longitude.

To find the distance.

| | |
|---|---|
| As the cos. of the course 5 points . | 9.74474 |
| Is to the difference of latitude 235 . | 2.37107 |
| So is radius . . . . | 10.00000 |
| To the distance 423 . . . | 2.62633 |

To find the difference of longitude.

| | |
|---|---|
| As cos. middle latitude, 44° 22′ . | 9.85423 |
| Is to the tang. of the course 5 points | 10.17511 |
| So is the difference of latitude 235 . | 2.37107 |
| To the difference of longitude 492 | 2.69195 |
| Then from the longitude left . | 15 . 6 W. |
| Take the difference of longitude 492, or | 8 . 12 E. |
| And the remainder is the longitude the ship is in . . . . | 6 . 54 W. |

Besides the cases which we have now given, many others might be deduced from the same principles; but as the methods of resolving them bear a great resemblance to those which we have now considered, it seems quite unnecessary to dwell longer on the subject.

*Mercator's sailing.*—Though the meridians do all meet at the pole, and the parallels to the equator do continually decrease, and that in proportion to the cosines of their latitudes, yet in old charts the meridians are drawn parallel to one another, and consequently the parallels of latitude made equal to the equator, and so a degree of longitude on any parallel as large as a degree on the equator; also in these charts the degrees of latitude are represented equal to each other, and to those of the equator. By these means the degrees of longitude being increased beyond their just proportion, and the more so the nearer they approach the pole, the degrees of latitude, at the same time, remaining the same, it is evident places must be very erroneously marked down upon these charts with respect to their latitude and longitude, and, consequently, their bearing from one another very false. To remedy this inconvenience, so as still to keep the meridians parallel, it is plain that the degrees of latitude must be protracted or lengthened in the same proportion as those of longitude are, so that the ratio in easting and westing may be the same with that of southing and northing, and consequently the bearings of places from one another the same upon the chart as upon the globe itself; and to find by what proportion the degrees of latitude must be lengthened, let E P be a quadrant of the meridian, (Fig. 16.) E a point on the equator, P the pole, C E the radius of the equator, L B the cosine of the latitude of the point L, and C S the secant of that latitude. Then, because the triangles C L A, C S E are similar, C A : C L : : C E : C S; that is as cos. lat. : rad. : : rad. : sect. lat.; but as cos. lat. is to rad., so is any part of that parallel of latitude to a similar part of the equator; therefore, as radius is to sect. lat., so is any part of the parallel to a similar part of the equator. But the equator is equal to the meridian, both being great circles of the sphere; and, in Mercator's chart, every parallel of latitude is equal to the equator, consequently, the natural length of any part of a parallel of latitude is to its length on Mercator's chart as radius is to the secant of the latitude; and, therefore, to enlarge the several parts of the meridian in the same proportion, the natural length of any part of the meridian must be to its length on Mercator's chart as radius is to the secant of the latitude of that part of the meridian. Now, let A and C (Fig. 17.) represent any two places lying in different latitudes and longitudes properly laid by the principles of Mercator's projection; also let A D be the meridian of the place A; draw A C, and from C let fall the perpendicular C D; set off the proper difference of latitude from A to B, and draw B E parallel to D C; then A E is the true distance of the places A and C, A C the enlarged distance, A D the enlarged difference of latitude, D C the difference of longitude, B E the departure, and the angle B A E the course; and, since B E is parallel to D C, the triangles A B E, A D C are evidently similar, and therefore the sides are proportional. Hence arise the solutions of the several cases in this sailing, which are as follow.

*Case* 1.—Given the latitudes and longitudes of two places, to find the course and distance between them.

*Example.*—What is the course and distance from Cape Clear in Ireland, to the island of St Mary, one of the Azores.

| | | | |
|---|---|---|---|
| Lon. of C. Clear | 9° 50′ W. | Lat. 51° 18′ | Mer. parts 3597 |
| Lon. of St Mary's | 22° 56′ | Lat. 37° 00′ | Mer. parts 2393 |
| Diff. of long.<br>Or | 13° 6′<br>786 m. | Diff. Lat. 14 18<br>Or 858 m. | Mer. diff. of Lat. 1204 |

*Geometrical construction.*—Draw the line A D to represent the meridian of Cape Clear, (Fig. 18.) upon which lay off the meridianal difference of latitude 204; from D erect the perpendicular D E, make it equal to the difference of longitude 786, and draw the line A E, from A to B lay off the proper difference of latitude 858, and through B draw B C parallel to D E, then will the angle E A D be the course, and A C the distance.

Calculation.—To find the course.

| | |
|---|---|
| As mer. diff. of latitude 1204 . | 6·91937 |
| Is to the difference of longitude 786 | 2·89542 |
| So is radius . . . . | 10·00000 |
| To long. of the course 33° 8′ . | 9.81479 |

To find the distance.

| | |
|---|---|
| As cos. of the course 33° 8′ . | 0·07707 |
| Is to prop. diff. of lat. 858 . . | 2·93349 |
| So is radius . . . . | 10·00000 |
| To the distance 1024 . . . | 3·01056 |

*Case* 2.—Given one latitude the course and distance, to find the other latitude and difference of longitude.

Latitude and Longitude.

*Example.*—A ship takes her departure from a place in 51° 18′ N., longitude 9° 50′ W., and steers S. 33° 08′ W. till she has run 1024 miles. What is her present latitude and longitude?

*Geometrical construction.*—Draw the meridian A D, (Fig. 19.) make the angle D A E equal to the course 33° 8′, take A C equal to the distance 1024 miles, and from C draw C B perpendicular to A D; then will A B be the difference of latitude, which will be found, as under, to be 857·5, hence the latitude come to is 37° 1′, and the meridianal difference of latitude 1203, then make A D equal to 1203, draw DE parallel to B C, and D E will be the difference of longitude.

Calculation.—To find A B the difference of lat.

| | |
|---|---|
| As radius | 10.00000 |
| Is to the distance 1024 | 3.01030 |
| So is cos. of the course 33° 8′ | 9.92293 |
| To the difference of latitude 857.5 | 2.93323 |
| Then from latitude left | 51° 18′ N. |
| Take the dif. of latitude 857.5, or | 14° 17′ S. |
| And there will remain the present lat. | 37° 01′ N. |

Again from the merid. parts corresponding to . . . . 51° 18′ = 3597

Take the merid. parts corresponding to . . . . . . . 37° 01′ = 2394

And the meridianal difference of lat. will remain . . . . . . . . . = 1203

To find the dif. of longitude.

| | |
|---|---|
| As radius | 10.00000 |
| Is to tang. of course 33° 08′ | 9.81473 |
| So is merid. dif. of lat. 1203 | 3.08026 |
| To the dif. of longitude 785.2 | 2.89499 |
| To the longitude left | 9° 50′ W. |
| Add the dif. of longitude 785, or | 13° 05′ W. |
| And the present longitude will be | 22° 55′ W. |

*Case* 3.—Given two latitudes and course, to find the distance sailed, and difference of longitude.

*Example.*—A ship from latitude 54° 20′ N. sails south 33° 45′ east, till, by observation, she is found to be in latitude 51° 45′ north; what distance has she sailed, and what is the difference of longitude between the two places.

*Geometrical Construction.*—Draw A B to represent the meridian of the ship in the first latitude, (Fig. 20.) and from A to B set off the proper difference of latitude 155, also make A G equal, 257·9 the enlarged difference of latitude: Though B and G draw the lines B C, G K, perpendicular to A G; likewise draw A K, making an angle of 33° 45′—meeting the two former lines in C and K, then A C will be the distance, and G K the difference of longitude.

Calculation.—To find the difference of longitude.

| | |
|---|---|
| As radius | 10.00000 |
| Is to the merid. dif. of lat. 257.9 | 2.41145 |
| So is the tangent of the course 33° 45′ | 9.82489 |
| To the difference of longitude 172.3 | 2.23634 |

To find the distance.

| | |
|---|---|
| As radius | 10.00000 |
| Is to the proper dif. of latitude 155 | 2.19033 |
| So is the secant of the course 33° 45′ | 10.08015 |
| To the distance 186.4 | 2.27048 |

Latitude and Longitude.

Consequently the ship has sailed south 133° 45′, east 186.4 miles, and has differed her longitude 172·3 miles easterly.

*Oblique sailing.*—Oblique sailing is the application of oblique-angled plane triangles to various cases at sea; as in coasting, approaching or leaving land, surveying coasts or harbours, &c. The questions in it being innumerable, we shall only give a few of the most useful.

*Example.*—Coasting along the shore, I saw a cape bear from me N. N. E., and after sailing N. W. by W. 20 miles, I observed the same cape bear from me N. E. by E.—what distance is the ship from the cape at each station?

*Geometrical Construction.*—Draw the circle N. W. S. E. to represent the compass, (Fig. 21.) N. S. the meridian, and W. E. the east and west line, and let C be the place of the ship in her first station; then from C set off upon the N. W. by W. line, C A 20 miles, and A will be the place of the ship in her second station: Again from C draw the N. N. E. line C B, and from A draw A B parallel to the N. E. by E line C D, and continue it until it meets C B in B, the place of the cape, then C B will be the distance of it from the ship in its first station, and A B the distance in the second.

Calculation.—In the triangle A C B are given A C equal to 20 miles, the angle A C B equal to 78° 45′, the distance between the N. N. E. and N. W. by W. lines, also the angle A B C equal to B C D 33° 45′, the distance between the N. N. E. and N. E. by E. lines; and, consequently, the angle A equal to 67° 30′. Hence to find C B the distance of the cape from the ship in her first station.

| | | |
|---|---|---|
| As the sine of the angle B | 33° 45′ | 9.74474 |
| Is to A C the distance run | 20 miles | 1.30103 |
| So is the sine of B A C | 67° 30′ | 9.96562 |
| To C B | 33.26 | 1.52191 |

To find A B.

| | | |
|---|---|---|
| As the sine of B | 33° 45′ | 9.74474 |
| Is to A C | 20 miles | 1.30103 |
| So is the sine of C | 78° 45′ | 9.99157 |
| To A B | 35.31 | 1.54786 |

The distance of the ship from the cape at her second station.

*Example* 2.—Coasting along the shore, I observed two capes, the first bore N. by E., and, at the same time, the second bare N. E. ¾ E.; but, by the chart, these capes bear from each other N. W. ¼ W., and S. E. ¼ E. distant 21 miles; at what distance am I from both places at that time?

*Geometrical Construction.*—Describe the circle N.W. S. E., (Fig. 22.) and let the centre A represent the ship's place, draw the lines A B and A C, N. by E., and N. E. ¾ E., also draw the N. W. ¼ W., and S. E. ¼ E. line representing the bearing of the capes from each other; on which, from A to D lay off 21 miles, the distance between the capes; through D, draw D C parallel to the N. by E. line, and through C, draw C B parallel to the N. W. ¼ W., and S. E. ¼ E. line, then B will represent the place of the first cape, C that of the second cape, A B the distance of the

Latitude and Longitude.

first cape from the ship, and A C the distance of the second cape.

Calculation.—In the triangle A B C are given the angle B A C $3\frac{3}{4}$ points, the arch between the N. by E and N. E. $\frac{3}{4}$ E. lines; the angle A B C $5\frac{1}{4}$ points, the interval between the S. by W., and S. E. $\frac{1}{4}$ E. lines; and the angle A C B 7 points, the interval between the N.W. $\frac{1}{4}$ W., and S.W. $\frac{3}{4}$ W. lines, and the side B C 21 miles, to find the sides A B and A C.

To find the side A B.

| | |
|---|---|
| As sine angle A $3\frac{3}{4}$ points . . . . . | 9.82708 |
| Is to side B C 21 m. . . . . . . . | 1.32222 |
| So is sine angle C 7 pts. . . . . . . | 9.99157 |
| To the side A B 30.67 . . . . . . . | 1.48671 |

To find the side A C.

| | |
|---|---|
| As the sine angle A $3\frac{3}{4}$ points . . . . | 9.82708 |
| Is to side B C 21 . . . . . . . . | 1.32222 |
| So is sine angle B 5 $\frac{1}{4}$ points . . . | 9.93335 |
| To the side A C 26.82 . . . . . . | 1.42849 |

*Example 8.*—Coasting along the shore I saw two headlands, the first bare from me N. W. by N., and the second N. N. E.; then running E. by N. $\frac{3}{4}$ northerly 20 miles, I found the first bare from me W. N. W. $\frac{1}{2}$ W., and the second N. by W. $\frac{1}{2}$ W., what is the bearing and distance of these two headlands.

*Geometrical Construction.*—Draw the circle N. W. S. E. to represent the compass, (Fig. 28.) and let C be the first place of the ship, from which draw the N. W. by N. line C B, and the N. N. E. line C D, also the E. by N. $\frac{3}{4}$ N. line C A, which make equal to 20, from A draw A B parallel to the W. N. W. $\frac{1}{2}$ W. line, and A D parallel to the N. by W. $\frac{1}{2}$ W. meeting the two first lines in the points B and D; then B will be the first, and D the second headland—join the points B D, then B D will be the distance between them, and the angle C B D their bearing from the N. N. E. line.

Calculation.—In the triangle A B C are given the angle B C A 104° 04′, the distance between the N. W. by N. line and the E. N. E. $\frac{1}{4}$ E. line, the angle B A C 36° 34′, the distance between the W. S. W. $\frac{1}{4}$ W. line, and the W. N. W. $\frac{1}{2}$ W. line, the angle A B C 39° 22′, the distance between the E. S. E. $\frac{1}{2}$ E. line and the S. W. by S. line, also the side C A equal to 20 miles; whence,

To find C B.

| | | |
|---|---|---|
| As the sine of C B A . . . . | 39° 22′ | 9·80228 |
| Is to A C . . . . . | 20° | 1·30103 |
| So is the sine of C B A . . . | 36° 34′ | 9·77507 |
| To C B . . . . . . | 18° 79′ | 1·27382 |

The distance between the first headland and the ship in her first station.

Then in the triangle A C D are given the angle A C D, equal to 47° 49′, the distance between the E. N. E. $\frac{1}{4}$ E. line, and the N. N. E. line; the angle C A D 92° 49′ the distance between the W.S.W. $\frac{1}{4}$ W. line, and the N. by W. $\frac{1}{2}$ W. line; the angle C D A 39° 22′, the distance between the S. S. W. line, and the S. by E. $\frac{1}{2}$ E. line, also the side C A equal to 20. Hence,

To find C D.

| | | |
|---|---|---|
| As the sine C A D . . . . | 39° 22′ | 9·81228 |
| Is to A C . . . . . . . . | 20° | 1·30103 |
| So is the sine of C A D . . | 92° 34′ | 9·99960 |
| To C D . . . . . . . . . . | 31° 5′ | 1·49835 |

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The distance between the second headland and the ship in her first situation.

Also in the triangle B C D are given B C 18° 79′, C D 31° 5′, and the angle B C D equal to 56° 15′, the distance between the N. W. by N. line and the N. N. E. line. Hence,

To find the angle C D B.

| | | |
|---|---|---|
| As the sum of the sides . . . | 50° 29′ | 1·70148 |
| Is to the difference of the sides | 12° 71′ | 1·10415 |
| So the tangent of $\frac{1}{2}$ sum of the unknown angles . . | 61° 52′ | 10·27189 |
| To tang. of half their diff. . . | 25° 18′ | 9·67456 |

Consequently the angle C B D is 87° 10′, and the angle C D B 36° 35′. Hence the bearing of the first headland from the second will be S. 59° 8′ W. or S. W. by W. $\frac{1}{2}$ W. nearly; and

To find the distance between them.

| | | |
|---|---|---|
| As the sine of B D C . . | 36° 35′ | 9·77524 |
| Is to B C . . . . . . . . | 18° 79′ | 1·27382 |
| So is the sine of B C D . . | 56° 15′ | 9·91985 |
| To B D . . . . . . . . . | 26° 21′ | 1.41843 |

The distance between the two headlands.

A variety of other cases might be given; but we conceive that those which we have already considered are quite sufficient for most practical purposes, as well as for shewing the method by which any case may be deduced from the principles upon which the different sailings depend.

NAVIGATION, INLAND, a term of more extensive import than canal, being applicable to navigable rivers and canals, whereby communication is formed betwixt different places, and commercial advantages are distributed through the interior of a country. The navigation of every country must have commenced on its rivers. After the political state of society had undergone considerable improvement, and the emollient arts of life had reached some degree of perfection, the expedient was resorted to of forming a passage for vessels, by making an artificial cut in the ground, and supplying it with water from rivers and lakes. Artificial canals were originally made to protect the low lands adjacent to the mouths of considerable rivers, and to direct the flood waters for the purposes of agriculture; and they were, no doubt, first established in the Deltas of the Nile and the Euphrates, the great Chinese rivers, and the estuaries of the Po and the Rhine. According to Herodotus, the Cnidians, a people of Caria in Asia Minor, at one time designed to cut through the isthmus which joins the peninsula to the continent, but were dissuaded from the attempt by an oracle. The Greeks and Romans formed the plan of dividing the isthmus of Corinth, in order to open a communication by the Ionian sea into the Archipelago. This project, though liberally encouraged by Demetrius Poliorcestes, Julius Caesar, Caligula, and Nero, proved altogether unsuccessful. Indeed the efforts of the ancients, in constructing canals, were of little avail; for, being entirely ignorant of the advantages to be derived from water locks, they directed their whole attention to the making of level cuts. Owing to the admirable invention of the lock, inland navigation has, in modern times, assumed a new aspect, and canals have been extended through countries where they had never been before.

The construction of canals by locks is attended with the most desirable advantages. The term *lock*, in inland navigation, denotes a kind of canal inclosed between two gates,—the upper denominated the sluice-gate, and the lower the flood gate, placed at such a distance from each other as the size of the vessels that navigate the canal renders necessary. These gates serve to confine the water, and facilitate the passage of boats in passing up and down the stream. The walls which constitute the lock are entirely of solid masonry, and parallel to each other. The gates consist of two leaves, which open and shut with a lever, or wheel and pinion, and meet in the middle of the water generally at an obtuse angle. The side walls of the locks are of equal thickness from the base upwards, leaning a little backwards, so as to throw back the centre of gravity, and thus enable the wall to resist the lateral pressure. In the best locks, the leaves are curved, to give them greater strength.

Inverted arches for the bottom of locks have been adopted, particularly on good foundations. The profile commences at the bottom with a considerable inclination, and rises gradually, in a curved form, till, at the summit, the wall is perpendicular to the horizon. Without endeavouring to illustrate the pressure of the earth against the walls of the lock, the best angle for the gates to shut at,—subjects which have long engaged the serious attention of our chief engineers without their coming to any definite conclusion, we deem it sufficient merely to mention the usual practice and explain the manner of operation. While a vessel is ascending, the under gate of the lock is opened till she is quite within the lock, when it is shut. A communication, sometimes through the upper gate, at other times through the adjoining ground, with the upper part of the canal is opened, through which the water enters the lock, and raises the vessel gradually till it is on a level with the upper part of the canal, when the upper gate is opened easily, since the pressure of the water is removed; then the vessel proceeds on her course. The reverse of this takes place in the case of the vessel descending. The general appearance of a canal with locks, aqueducts, &c. is given in Plate 138. together with a plan of one of the Caledonian canal locks, as being of the largest and most accurate construction.

*England.*—The inland navigation of England is extensive, as might naturally be expected from the spirit of commercial enterprise which characterizes its inhabitants. The Car Dyke, a canal 40 miles in length, extending along the borders of the fens, from the river Nen at Peterborough to the river Witham near Lincoln, is of unknown antiquity, and was certainly intended for navigation. The Foss Dyke, which was cleared out by Henry I., connects the Witham at Lincoln with the Trent above Gainsborough, by a level cut of 11 miles. It is now in use, and is perhaps the oldest canal in England.

The free navigation of our great rivers seems to have frequently attracted the attention of the legislature, and many improvements were thus occasioned in the river and canal navigation. The Stuarts, finding the knowledge of the English engineers with regard to embankments, drains, canals, rivers, and waterworks, rather defective, brought engineers from Holland, where such works were better understood. The Dutch artists communicated intelligence to English engineers, who are now, perhaps, the most intelligent and enterprising of any in the world. The consequence has been, that the navigation of the Thames, the Medway, the Severn, the Mersey, the Humber, and many other rivers which our limits do not permit us to particularise, has been much improved and enlarged.

The Grand Trunk canal, which we have already noticed under the article BRINDLEY, extends from the capital through the midland counties towards the extremity of England, whence a number of subordinate cuts branch out to the various commercial and manufacturing towns, thus connecting them into one whole by a reticulation of canals spread over the greater part of the country.

As a minute description of the inland navigation of England would necessarily occupy a very considerable space, we shall content ourselves with describing one or two canals, which are nearly similar to the others, or differ only in some of their subordinate parts.

Between Gravesend and Rochester, a narrow neck of land projects northward about 12 miles towards Sheerness at the junction of the Thames and Medway. From London to Chatham and Rochester, by the present circuitous route, the distance is about 30 miles; and round the point separating the Thames from the Medway, the passage, in easterly gales, is sometimes dangerous. Across the neck of land the distance is only about seven miles. Part of the canal which takes this direction passes through flat marshy ground, and along two and a-half miles of a chalky ridge, in which a tunnel has been cut, and the canal has been lately opened for the purpose of navigation.

In the year 1804 the Royal Military canal, of which Mr Pitt was a great promoter, was commenced under the direction of the quarter-master general, his assistant, Colonel Brown, having the management of the practical operations, in which the Royal Staff corps executed the artificers work, and the waggon-train the carriage work. Navigators were employed in the excavation, and three steam engines were insufficient to drain the works, the difficulties experienced were so considerable. This canal was finished in 1806. As it was originally intended as a line of defence, and a rallying point for troops in the event of a repulse after an engagement on the beach, ramparts were to have been constructed on the interior side from the river Rothes under Pleyden heights to Rye at Shorncliffe, and a tunnel driven through the shingle beach there 300 feet long and 25 superficial feet in the section. The river Rothes fluctuating a little, rendered a lock necessary on that end of the canal. This work, which was intended to serve the double purpose of a canal and line of defence, at the time it

*Fig. 1.*

*Canal Iron Aqueduct*

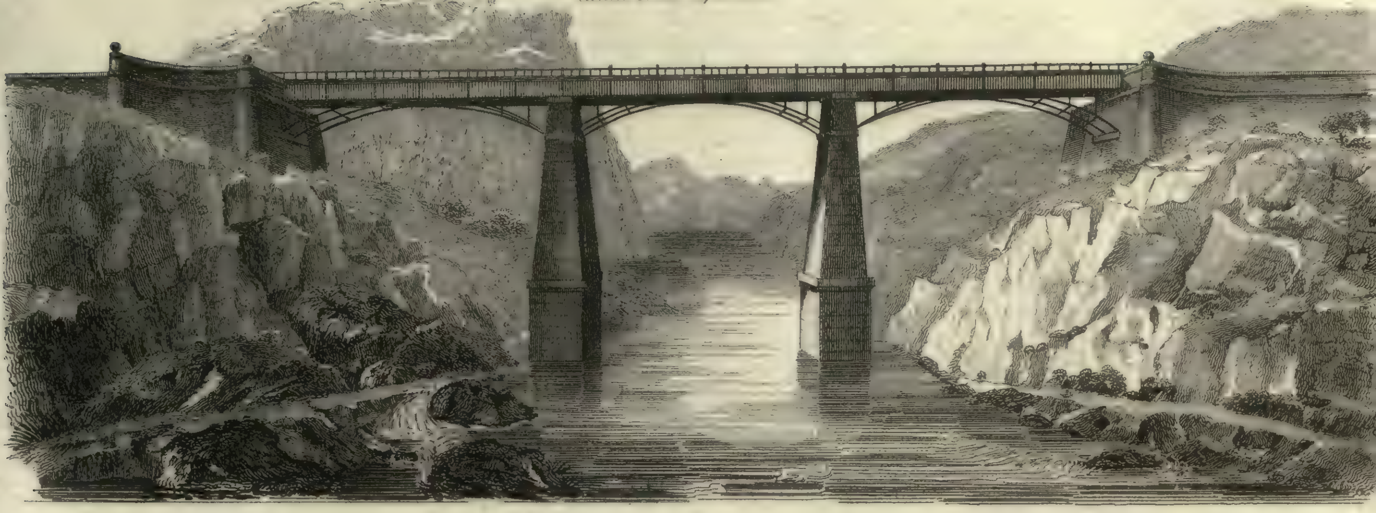


*Fig. 2.*

*Section of a Lock*

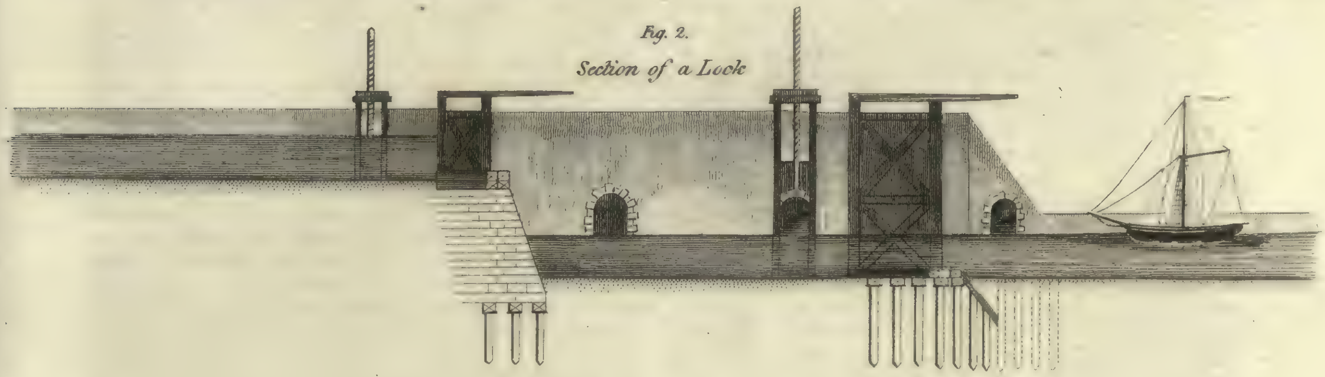


*Fig. 3.*

*Ground Plan*

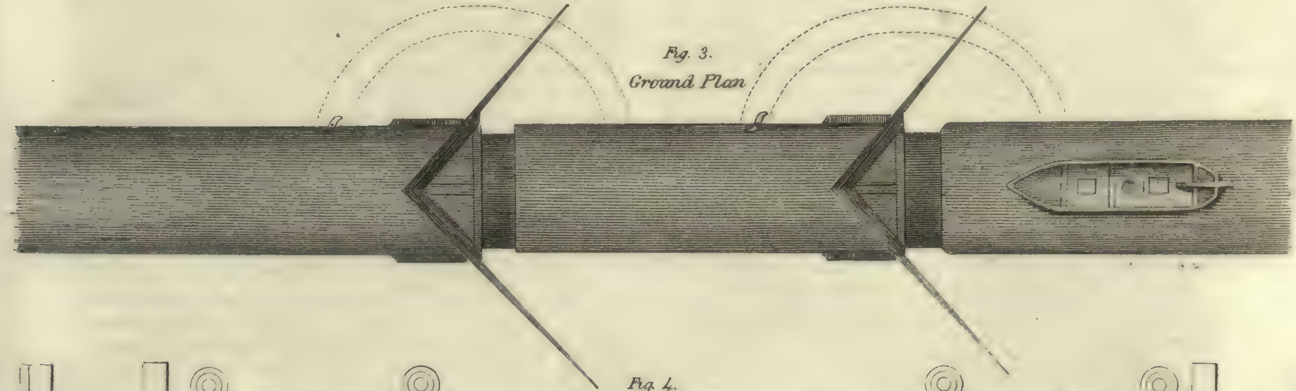
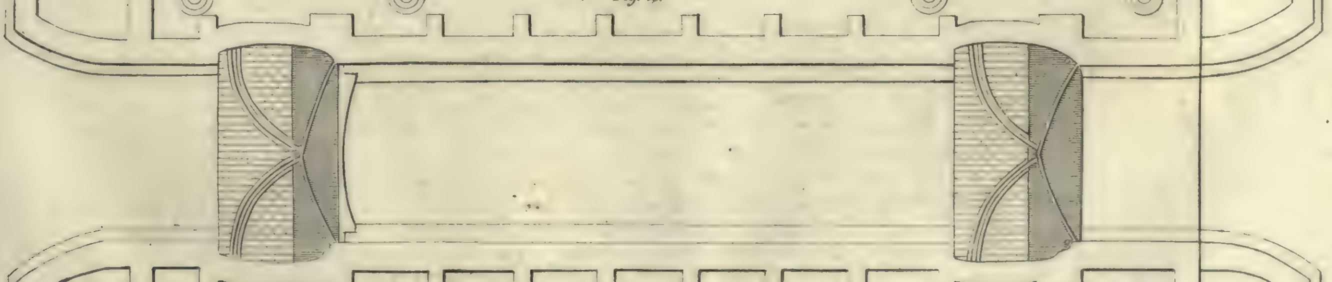


*Fig. 4.*



*Plan of one of the Caledonian Canal Locks*

Engraved for the Encyclopaedia Edinensis by W. Miller

was projected was from 72 to 62 feet wide at the water's surface, from 36 to 30 feet at the bottom, and 9 feet deep. Along the land side was constructed a line of parapets cannon proof, and a military road 30 feet in breadth. This canal line is laid out in angles, after the manner of a fortification, so that the successive reaches may flank each other, having locks where necessary 72 feet long and 16 feet wide.

England possesses four great commercial ports: On the eastern coast, London in the basin of the Thames, and Hull in the basin of the Humber; on the western coast, Bristol in the basin of the Severn, and Liverpool in the basin of the Mersey. These four basins, and the territory which separates them, does not comprehend the half of Great Britain; but they include the greatest and most important part of the inland navigation of England. It is in this territory that the most populous and industrious cities are found, and the richest counties.

*Scotland.*—The sea coasts of Scotland are intersected by numerous friths running considerably into the country, which greatly facilitate inland navigation. The friths of Forth, Tay, and Clyde are, among the great estuaries of Scotland, the most important, as affording easy access to Edinburgh, Glasgow, Dundee, and Perth. These may be reckoned the most commercial cities in the country, and are greatly benefited by their navigable rivers.

It soon became evident that a communication between Edinburgh and Glasgow, or at least between the friths of Forth and Clyde, by means of a canal, would be very advantageous to the trade of Scotland. So early, indeed, as the time of Charles II., a proposal was made for cutting a canal through that vale of Scotland connecting the friths of Clyde and Forth, nearly in the direction of the line of Graham's Dyke or Antoninus' Wall.

The subject being resumed in 1722, a survey was made. Nothing farther was done, however, till 1761, when, at his own expense, Lord Napier caused a survey, plan, and estimate be made. By the Trustees for Fisheries, &c. in Scotland, another survey was made in 1764; and about two years afterwards, when the bill was nearly procured in Parliament for making a canal four feet deep and 24 feet broad, the subscription was given up, and a new one commenced, for a canal seven feet deep, estimated at L.150,000. An act of Parliament being obtained for Mr Smeaton's plan, the practical operations commenced on the 10th of June 1768. The eastern extremity of this canal is situated in the river Carron, near its junction with the Forth, where, at spring tides, there is a rise of 18 feet. Connected with this are the Monkland canal, and the Edinburgh and Falkirk Union canal, by which a communication by water is formed directly between Edinburgh and Glasgow. There are several fine aqueducts on this canal, one of which is at Slateford near Edinburgh, and another on the river Avon. The Union canal meets the Forth and Clyde canal near Falkirk. A tunnel has been found necessary, as well as a considerable number of locks near the place of junction.

Connected with the Clyde are the Monkland canal for conveying coals to the city of Glasgow, and the Paisley and Ardrossan canals, connecting the counties of Renfrew and Ayr. The Crinan canal, also, is of great benefit to vessels trading to the Western isles and Highlands, by enabling them to sail up Loch Fine, and cross the country to the sea at Loch Crinan, thereby cutting off the circuitous passage round the Mull of Cantyre.

One of the most important and extensive canals in Great Britain is the Caledonian. It was undertaken for the purpose of admitting the passage of ships of considerable burden, and even of frigates of 32 guns, from the eastern to the western sea. Various reports were made upon this undertaking, by our most able civil engineers and naval men, previous to the commencement of any of the operations. Besides affording the advantage of a passage to vessels of considerable burden, it opened up a large portion of the Highlands to the privileges of trade and commerce, and thus mitigated the evils experienced by the Highlanders in consequence of the change in their former pursuits and mode of living. Several acts were obtained for carrying this grand project into effect, and ample grants have been made from time to time by Parliament for its completion, which now (1824) is nearly effected in its full extent.

The dimensions first adopted were, after due consideration, supposed to be rather too small; but those at last resolved upon by the commissioners, at the recommendation of the celebrated engineers Telford and Jessop, were, that the locks should be 172 feet long, 40 feet wide, and 20 feet deep. The works of excavation and embankment are 20 feet deep, 50 feet wide at the bottom, and 110 feet wide at the surface of the water-line of the canal.

The extent of the canal to be formed and cut is stated to be about 21½ miles, and the loch or lake navigation about 37½, making the total distance of inland navigation from sea to sea nearly 59 miles. The number of locks are about 23, built of strong masonry, and the banks slope about 18 inches in a foot.

During the year 1803, some preparatory operations were completed, and shortly after the general prices of labour were fixed, and materials made choice of, all of them of the best quality that could be obtained. The most considerable difference in these consisted in the ease or difficulty with which they could be procured. Thus, at the eastern extremity, the quarry of Redcastle, from which the cut stones were brought, is only at the distance of about five miles from the work. On the west side, these were brought from the Cumbrae isles in the frith of Clyde, a distance even by the Crinan canal of about 100 miles. On the east side, the sea lock is near Clachnagary, extending about 400 yards into the sea beyond the high-water mark, where at spring-tides a depth of water of 30 feet is expected. This tide lock, which is perhaps the most extraordinary in the whole line of the canal, has a rise of eight feet six inches. The second lock contiguous to the sea lock is just within high-water mark, and close to the fishing village of Clachnagary. This lock has a rise of six feet, and forms a division between the sea lock basin and the great basin of Muirton, containing an area of about 20 acres. This basin, which is rather of an irregular figure, is formed by works of excavation and embankment, has a wharf wall of considerable extent, and is defended by projecting mounds on each side of the sea lock sufficient to defend it from the waves of the Beauly firth, while the exterior bank of the Muirton basin is protected by a dyke of considerable extent. Over the canal there are several handsome turning or swivel bridges. There are four locks at Muirton, each having a rise of eight feet. The lower and upper are more liable to accidents from ships coming against them than any of the intermediate ones, which are formed of great cast-iron bars covered with strong oak planks. The leaves of these gates measure 30 feet in height and 22 feet in breadth. The *heel* of the gate turns upon a pivot, while the outer extremity moves upon a roller contrived to suit the ground, in which a cast-iron segment is laid, where the roller traverses in opening and shutting the gate. Though these enormous gates weigh above 40 tons, they are easily opened and shut by one man on each side of the lock turning a windlass attached to a wheel and pinion.

The length of the canal between Muirton locks and Loch Ness is about five miles, through a soil light and gravelly, and on the whole very bad for canal work. Between Muirton and Doughfour, great difficulty was experienced from this cause, as well as from works and embankments for altering the bed of the river Ness, and protecting the banks of the canal from its attacks.

In this canal there are regulating locks, for retaining in the great lochs the superabundant water collected from the adjacent country in great rains or sudden thaws, which, by raising the river Ness, might endanger the works of the canals. By means of these locks a gradual discharge is occasioned.

The regulating lock for Loch-Doughfour and Loch-Ness, has a rise of six feet six inches, so as to contain the vast quantities of water falling into Loch-Ness from sudden rains, and to admit of its discharge so gradually as to produce no injury to the canal. In some places of these locks, the water was too shallow for the navigation of such large vessels as were to pass through the canal, and the deepening of these constituted one of the most difficult operations in the undertaking. The deepening of Loch-Doughfour has been effected partly by a very powerful dredging machine, driven by a steam-engine floated upon a strong barge. To procure a greater depth than can possibly be obtained by the dredging machine, a dam is placed across the eastern end of Loch-Doughfour to raise the waters to a proper depth. Loch-Ness is in general deep enough, even quite to its banks, being in the deepest part 130 fathoms. In the middle district of this canal, extending to about 12 miles from Fort Augustus, to the west end of Loch-Lochy, the works have been chiefly confined to cutting the ground. The height of the highest point above the east sea being 94 feet, and as 53 feet of this has been past in rising to Loch-Ness, 41 feet only are left for the rise by lockage in the middle district. This is overcome by four locks at Fort Augustus, one at Callachie, and a regulating lock near Loch-Oich. The canal only falls 90 feet from the summit just mentioned to Corpach at the western extremity, and somewhat resembles the eastern district in its general outline. There are several aqueducts in this part of the canal; and over the Mucomer channel of the river Lochy there is a handsome stone bridge of two arches. At the western extremity, near Lochiel, there is a great chain of eight locks, after which the canal passes through Corpach Moss, where a double lock is situated, connected with a basin measuring 750 feet in length and 300 in breadth, forming a communication with Lochiel by two mounds projecting about 1000 feet into that branch of the Western ocean.

*Ireland.*—The unfortunate Earl of Stafford first suggested the improvement of the river navigation in Ireland; but it was not till the time of Queen Anne, that any legislative measures were taken for the purpose. The level surface of the country in general, and the numerous loughs with which Ireland abounds, are highly favourable for the extension of inland navigation. In 1703 it was proposed to improve the navigation of the Shannon from Limerick to James Town in Leitrim, as well as that of the Barrow and Boyne, and to form a canal from Lough Neagh to Newry. It does not appear, however, that any farther steps were taken at this time. Several petitions were presented to the Irish parliament between the years 1750 and 1760, relative to these projects, and were attended with various success. The Tillage committee reported, that inland navigation was the most effectual means to promote their views, especially from Dublin to the Shannon. The present Royal and Grand canals were then in agitation.

The Grand canal commences at the Liffey, near its mouth, where there is a floating dock capable of containing about 400 ships, with a draught of 16 feet water, three entrance locks, and three graving docks. The canal then proceeds by the south side of the city of Dublin to James street harbour, and thence westward through the counties of Dublin, Kildare, and King's county, to the river Shannon, near Banagher, with branches to the Barrow and Athy, and to various other places. The summit level is 240 feet above the sea, and 160 above the Shannon; the width is 25 feet at bottom, 40 at the surface of the water; the depth is 6 feet in the course of the canal, but only five feet on the lock sills. There are five double and 29 single locks between Dublin and Tullamore, and thence 10 to the Shannon. The length of the locks is 70 feet, the width 14½, and the average rise about 9 feet. On the Barrow line, from Lowton to Athy, there are 10 single, and two double locks. The only aqueduct of note is about 15 miles from Dublin, where the canal crosses the Liffey.

The Shannon, which is the largest river in Ireland, rises in Lough-Allen, in the county of Leitrim, and running southwards about 100 miles to Limerick, where it enters the tideway, it then takes a westerly direction for about 50 miles to the Atlantic ocean. This river, in its course, expands into a variety of wide lakes, the largest of which are Lough-Ree and Lough-Derg. It is joined by the Royal canal at Tarmon-

Inland Navigation.

barry, by the Grand canal at Shannon harbour near Banaghar, and has been rendered navigable through the greater part of its course. On the shores of Lough-Allen are valuable mines of coal and ironstone, and, in the vicinity of Lough-Derg are quarries of excellent slate, which, by means of this navigation, are readily exported. The Shannon is navigable for ships of 300 tons as far as Limerick, where a navigation partly on the river and partly on the canal commences, in order to avoid the rapids in passing to Lough-Derg. Lough-Derg is navigable from Killaloe to Fortumna, a distance of about 25 miles. At the upper end of Lough-Derg, the Shannon is connected with the Grand canal for about 50 miles, and the difficulties of the navigation are obviated by locks and cuts. A little above Athlone is Lough-Ree, about 16 miles in length, terminating at Lansborough, where the Upper Shannon navigation commences, extending nearly 33 miles to Leitrim, fit for boats of four feet water. Here, however, the navigation becomes very imperfect, being in wide reaches of the river with shallow shores destitute of track ways, which defect can be perhaps best obviated by the employment of steam-boats.

*France.*—Although in France canals are not so numerous as in England, yet there are some equally important, which indicate no small degree of enterprise. From that of Languedoc, which was cut during the reign of Louis XIV. not only France, but all Europe, may learn how, in extending inland navigation, the greatest barriers which nature can throw in the way may be surmounted by ingenuity and labour. The original plan of this canal was formed by Francois Andreossy, who, as soon as he had arranged it, communicated his design to P. Riquet, by whom it was presented to the minister Colbert in 1664. Colbert ordered the whole tract and design to be examined in 1665, by M. Clerville, the commissary-general of fortifications, who drew out a report and plan, which were afterwards contracted upon and carried into effect. The course which the canal pursues lies across the isthmus which connects the peninsula of Spain with the south of France. It consists of a kind of valley bounded by the Rhone and the northern skirts of the Pyrenean mountains. One part of this valley extends eastward, and through it flow the rivers Fresquil and Aude. The other leads from the summit of the isthmus to the flat shores of the Mediterranean on the opposite side of the mountain. The river Lers passes in a north-western direction to the city of Toulouse, situated upon the Garonne, which empties itself into the Bay of Biscay, a little way north of Bourdeaux. By this means an inland communication is formed between the Bay of Biscay and the Mediterranean, so as to avoid the circuitous passage round Spain. The great difficulty, however, which presented itself, was to supply the summit of the Black mountain with water. Its height and extent was great, and most of it covered with forests. Still there were numerous streams of an equal height, although no one in itself was adequate to the purpose required. It was therefore found necessary to collect them in a reservoir or feeder, which is ten feet wide and three deep of running water, embracing altogether eight separate streams. Above three miles of this feeder is cut in rock; and at Campmases there is a tunnel one hundred and twenty-five yards in length and nine feet in diameter. After this it occupies the channel of the Laudat for three miles, until it joins the feeder from the river Sor, when it proceeds across the plain, in a feeder of 12 feet wide and three deep, to the basin of Naurause, a distance of $38\frac{1}{2}$ miles. The feeder which passes across the plain was, at the time it was constructed, intended for navigation. On this account it was furnished with 14 locks; but it was found upon trial not to satisfy the views of those who made it. They consequently abandoned their original design, and it is now employed only for a feeder. There was also at one time a large reservoir at Naurause, 426 yards in length and 320 in breadth, containing frequently seven perpendicular feet of water. This, however, has long since been filled up with mud, and planted with poplars, and the feeder now passes along the side of it to the summit of the canal. The canal itself at the western end is connected with the river Garonne, from which it ascends by eight locks to the city of Toulouse. After leaving this city it passes along the southern side of the river Lers, and by an elevation of thirteen locks reaches Villefranche, where it crosses the Lers, and then by five other locks rises to the summit of its elevation, making in all 26 locks for 207 feet of elevation in $23\frac{3}{4}$ English miles. On the opposite side of the mountain it descends by 37 locks along the southern side of the valley of Fresquil, until it reaches the point where that river falls into the Aude, which is not far from Carcassonne, it having in this distance crossed the Treboul and five smaller streams. The canal then passes across the Fresquil, and along the northern side of the river Aude, until it arrives at the town of Trebes by a descent of twenty-two locks, and after crossing other five streams. A large level then begins at the lock of Argens, and continues across the torrent Repudre, along the base of the mountain near Ventenac, and over the river Cesse, on the east side of which the canal of Narbonne branches off. Considerable windings then take place; the canal passes to the north of Capestang, and sweeps around the point of the mountain Ecurene, after which it crosses through the narrow ridge of Malpas by a tunnel of 181 yards in length, and rises to a level 17 miles in length, at the top of the chain of eight locks at Fonseranne. Upon leaving this chain of locks, and an intermediate one, the canal crosses the river Orb, and takes a southern direction until it passes the river Libron, when it proceeds as far as the river Herault, which it crosses to the north of Agde; and after winding round the southern extremity of a small lake called Bagnes, it enters the large lake Thau to the west, which brings it as far as the port of Cette on the coast of the Mediterranean. The distance from the summit at Naurouse to the port of Cette is $121\frac{1}{4}$ English miles, and the fall $621\frac{1}{2}$ feet; making the whole length of the canal 148 English miles.

The inland navigation of some other foreign countries besides France is well worthy of notice, especially that of the Netherlands, Switzerland, Sweden, Egypt, China, India, and America. Our limits do not admit of extending this article to greater length, but in the geographical department of this work the reader will obtain some account of the inland navigation of different countries.

**NAVIGATORS' ISLANDS**, a cluster of islands in the Pacific ocean, discovered by Bougainville in 1768, and so denominated by him from the singular circumstance of their inhabitants being almost constantly on the water, and pasing from one village to another in canoes. The villages are all situated in creeks by the sea-side, and have no footpaths from one to another. This group consists of ten islands, called by the natives Opoun, Leone, Fanfoue, Maouna, Oyolava, Calinasse, Pola, Shika, Ossamo, and Ouera. The most easterly as well as the most southerly of them is Opoun, which lies in W. Long. 169° 7', and N. Lat. 16° 7. They form one of the finest archipelagos of the South sea. The soil in these islands is extremely fertile, and the mildness of the climate renders clothing unnecessary. Oyolava is said to be equal to Otaheite in extent, fertility, and population, presenting the same beautiful appearance to vessels in the offing. La Perouse, who explored these islands in 1787, as commander of the ships Boussole and Astrolabe, informs us that the whole group produce the bread-fruit, the cocoa-nut, the banana, the quava, and oranges in abundance. He observed the sugar-cane also growing spontaneously on the banks of the rivers. The natives are described by him as the tallest, stoutest, and best proportioned people he had met with in the Pacific. The men are remarkable for a certain ferocity of countenance, which seems always to express either anger or surprize. Nor is this a false index of their temper, as he found them to be really thievish, treacherous, and ferocious. The natives of these islands are pretty well skilled in the arts of life. Their canoes and houses are constructed with taste, and they manufacture very fine mats and paper stuffs like those of Otaheite. They tattoo their bodies, so that they appear to be dressed. Nothing is worn by them on ordinary occasions but a girdle of sea-weed, which reaches from the loins to the knees, and is said to give them the appearance of the river-gods of ancient mythology.

**NAUMACHIA**, among the ancient Romans, was a show or spectacle representing a sea-fight. As it was their rivalship with Carthage that first induced the Romans to attempt ship-building, their vessels were originally formed for the purpose of war rather than of commerce, and were regarded as a sort of military engines. Mock sea-fights are supposed to have been introduced about the time of the first Punic war, as an excellent means of training seamen, as well as of entertaining the populace. For the latter purpose they were afterwards continued; and many individuals, for the sake of popularity, often caused these shows to be exhibited at their own expense. The term Naumachia came to be applied to the edifices in which these spectacles were exhibited, and which resembled the circus, the pit being formed for the reception of water. Several of these buildings were erected by different emperors in Rome.

**NAVY**, properly denotes the fleet of a prince or state. The royal navy of Britain surpasses every other in the world, and is not only the great ornament and defence of the island, but the guard of our foreign possessions, the dread of other nations, and the main bulwark of our power. It hath hitherto secured for us the empire of the seas. Our maritime situation rendered the navy an object of attention at an early period. In the reign of Elizabeth, devoted as she was to naval affairs, it did not exceed thirty-three ships, which was then regarded as matter of boast. Under the influence of the navigation acts it has been since greatly increased, and placed in the best order, so that it cannot fail to command the requisite supply of seamen on any emergency. At the conclusion of the late war the royal navy consisted of 1000 sail. The management of the whole is committed to the Board of Admiralty.

**NAXIA**, or Naxos, an island of Turkey in Europe, situated in the Grecian Archipelago, is the largest of the Cyclades, being 25 miles in length and 88 in circumference. It abounds in pomegranates, figs, oranges, lemons, citrons, and olives, with cedar trees and mulberries. The higher grounds afford excellent pasture for sheep and black cattle, while cotton, flax, barley, and wheat are cultivated in the vallies and plains. The wine of Naxia was much celebrated in former times; and to this day it is deemed the best in the Levant. In the mountains emery is found in great quantities, and formerly a species of green marble was discovered, called *ophites* from its being speckled with white spots like the skin of a serpent. On the western coast is a cape denominated by the Italians Capo Smeriglio, or Emerald cape, from the number of fine emeralds which are found in its vicinity. Naxia carries on a considerable trade in fruits, grain, silk, cattle, and oil. The original inhabitants of this island were Thracians, who, it is said, made a descent on Thessaly for the purpose of supplying themselves with wives. The population does not exceed 10,000, of whom the greater part are Greeks. The dress of the women is somewhat peculiar. Two pieces of black velvet waving on their shoulders have much the appearance of wings; another placed as a stomacher on the breast is finely embroidered, and frequently covered with small pearls.

*Naxia*, the capital, is delightfully situated on an eminence on the south side of the island. The Latins, who were once masters of Naxia, have their own enclosure; and the Greeks, who constitute the greater part of the inhabitants, occupy the new town to the east of the castle. Two of the four archiepiscopal sees in the island belong to this place. Near the once famous fountain of Ariadne, which is but a small rill, scarcely calculated to attract the notice of travellers, are the remains of a temple of Bacchus; and on the island is also an ancient marble tower surrounded with ruins, which is generally supposed to have been part of a temple dedicated to Neptune. Traces of a subterranean aqueduct have been discovered below the castle.

**NAZARETH**, a small town of Syria in Palestine, situated about 75 miles north of Jerusalem, and a few miles to the west of mount Tabor in the plains of Esdraelon. It is celebrated in Scripture as the place of our Saviour's conception and of his chief

NAZARITE, a term derived from the Hebrew, signifying *separated*, and used to denote those persons among the Jews who devoted themselves to the peculiar service of God, either for life, as Sampson and John the Baptist, or for a certain period. A Nazarite was bound by his vow to observe a greater degree of purity than might be attainable in ordinary circumstances. Being in a peculiar state of separation from mankind, he was not to cut his hair; he was to abstain from wine and strong drink; and was prohibited from attending a funeral, or entering a house while a corpse was there. The ritual which was observed by the Nazarites on making and completing their vow, is fully detailed in the books of Moses.

NEALING. See ANNEALING, and GLASS MANUFACTURE.

NEAP TIDES, those tides which fall lowest, and are by this name distinguished from spring tides, or those which rise highest. When the actions of the sun and moon conspire together, as at the time of new and full moon, the flux and reflux of waters in the sea become more considerable, and in this case they are called spring-tides. But while the one tends to elevate the waters the other depresses them, as at the moon's first and third quarters the effect will be exactly the contrary; the flux and reflux, instead of being augmented, will be diminished, and then they are called neap-tides. It must be observed, however, that the effect of these respective actions of the sun and moon does not appear exactly at the time they are strongest, but some days afterwards. Thus the highest spring-tides take place about three days after the full and change of the moon, and the lowest neap-tides about the same time after the quarters.

NEBULAE, a term applied to those stars which, being placed at an immense distance, appear to the naked eye like a thin cloud of diffused light. In some nebulæ, the Pleiades for example, stars are visible without the application of an instrument, in others none can be seen. When viewed through a telescope, the dim hazy light which, to the unassisted eye, presented the appearance of a white cloud, usually disappears, and the nebulæ is resolved into a collection of distinct stars, while other nebulæ not previously visible are detected, which telescopes of still greater power prove to be also clusters of stars. One nebula in Orion is thus found to contain 21 little stars; there are 40 in the Pleiades, and no fewer than 2500 in the constellation Orion. Of all the nebulæ, that which is most obvious is the galaxy, or milky-way, a large irregular zone or band of light, which crosses the ecliptic in Cancer and Capricorn, and is inclined to it in an angle of about 60 degrees. In a small portion of this zone Dr Herschell counted no less than 50,000 stars, and had reason to believe there were almost double that number. At one time it was imagined that the nebulæ in our hemisphere amounted to 103; but previous to the month of April 1784, this celebrated astronomer had discovered 466 more. It is his opinion that the starry heaven is replete with nebulæ, each forming a distinct and separate system independent of the rest. The milky-way he supposes to be that particular nebula to which our sun belongs, and very ingeniously endeavours to account for the appearance it exhibits.

NECESSITY, opposed to freedom, is the constraint of a cause or power in one aspect or another irresistible. For the doctrine of Liberty and Necessity, see MORAL PHILOSOPHY.

NECESSITY, in law, as it implies defect of free agency, diminishes responsibility, and is therefore one of the causes which make void the guilt of crimes. According to civilians, the plea of necessity is admitted first of all in the obligation of subjection, when an inferior is constrained by a superior to do what would be contrary to his own reason and inclination. The principal case in which this plea is allowed is that of the matrimonial subjection of the wife to her husband. A woman committing theft, burglary, or other civil offences, by coercion of her husband, or in his company, which is construed as coercion, stands excused from the crime. Such crimes as are not barely civil offences, but *mala in se*, or prohibited by the law of nature, are excepted, as murder, for example. Treason, too, though a crime which arises from the conventional institutions of society, yet being the highest, is excepted; so that no plea in coverture can be sustained for a wife.—Threats which induce a fear of death or other bodily harm, also constitute a species of compulsion or necessity, recognised in law under the name of *duress per minas.* In times of rebellion a man may be acquitted for acts through compulsion of the rebels, which would admit of no excuse in other circumstances. This, however, holds chiefly as to crimes created by society, not those directly opposed to moral principles or the law of God. A third species of necessity is, when a person, being constrained to choose one of two evils, chooses the least pernicious of the two. On this principle a man may be justified in doing what, without such obligation, would have been criminal; for example, those individuals whose office it is to arrest a person guilty of some capital offence, or to quell a riot, when they find their authority resisted, may beat, wound, or kill the offenders, rather than suffer the murderer to escape, or the riot to continue.—There is another case of necessity about which lawyers are not agreed, whether extreme want of food or clothing may justify the stealing of either, or even taking them forcibly from such as are supposed able to spare them. Foreign jurists in general hold the affirmative; but the law of England admits no such excuse.

NECKER, JACQUES, BARON DE, a financier and statesman, who, during the early part of the French revolution, acted a conspicuous part, was born in the year 1732 at Geneva, where his father was professor of civil law; and after acquiring a liberal education, he was sent, at the age of fifteen to Paris, and placed in a banking-house in that city. His punctuality and discretion were remarked by the banker, Thellusson, whose confidence and esteem he happily secured by his able management of some very important business at the Exchequer with which he was entrusted instead of the head clerk, and by which he realised to his master a profit of 500,000 livres beyond what had been really expected. In consequence of this fortunate transaction he was afterwards employed in the capacity of principal clerk in the banking-house, and was ultimately taken into partnership by his employer. After the death of Thellusson, he, in conjunction with some other individuals, commenced a banking establishment, by which in the course of 15 years he accumulated a capital of 6,000,000 livres.

By his financial talents Necker came into public notice in France in 1776, and in the following year he succeeded Turgot as comptroller-general of finance. His appointment to this office gave great satisfaction to the liberals, as he was the first Protestant who had been admitted to any important situation in the government since the revocation of the edict of Nantes. He served without a salary. He made many judicious arrangements, and materially improved the condition of the treasury. He had married Susanne Curchod, the object of Gibbon's early attachment, a lady of high intellectual powers, and distinguished for her literary acquirements as well as amiable disposition. Possessing such a wife, enjoying the general confidence of the nation, and gratified during his leisure hours by the society of Buffon, Marmontel, and other celebrated men of the age, he now spent five years, not without the labour and anxiety which the deep interest he took in his official duties necessarily occasioned, but seemingly the happiest in his life.

He had enemies, however, at court, who were eagerly waiting to seize the first opportunity that might be improved to his disadvantage. This at length occurred, when, soon after the publication of his *Compte Rendu*, in which he developed his plans of finance, he was induced by the unexampled popularity of that work, to apply with more spirit than prudence for a place in the council. His enemies eagerly seizing on this, made it a handle for vexatious discussions which forced him to resign his place, and retire to Copet, a chateau which he had purchased on the border of the lake of Geneva. In this retirement he published his treatise, *De l'Administration des Finances*, the warm reception of which, together with the increasing agitation of the kingdom, and the financial difficulties in which it was involved by Calonne his successor, induced him to return to Paris in 1787. The Notables being then assembled, he forthwith prepared a memorial to rebut the charge of malversation of which Calonne had accused him. Refusing to suppress this memorial, at the king's request, to whom he had submitted it, Necker was banished to St Ouen, a country seat at a considerable distance from the capital. Calonne's dismissal, however, and the appointment of Bienne to succeed him, being found inadequate to the emergency of the times, Necker was recalled in the following year, and reinstated in his office. The difficulties with which he had now to contend were truly appalling,—the treasury was exhausted, the taxation insufficient, the people impoverished and tumultuous, the court jealous of his principles, afraid of his popularity, and consequently disposed to counterwork his plans. Having acquired the chief direction of affairs, by the removal of Maurepas, the prime minister, he urged the king to assemble the States-general, who were accordingly convoked on the 5th of May 1789. The project of a limited monarchy had seemed to Necker the best remedy for the grievances of the nation, and the measure most likely to allay the ferment among all parties; but this project he found himself unable to carry in the wise and moderate form in which he had sketched it. An arrangement which his dread of the *noblesse* induced him to make, that the deputies of the *tiers état* should be equal in number to the two other orders, produced the junction of all in one National Assembly, where the democratic influence soon prevailed; and the plan of a constitution by which he still hoped to quiet the rising demands of that party was so altered and curtailed by the king, that Necker refused to be present when it was read. Not choosing to concur in an attempt to overawe the deputies by a military force, he received secret orders on the afternoon of the 11th July 1789, to leave Versailles privately within twenty-four hours. He instantly complied and set out for Brussels. This event, so soon as it was known, together with the gradual approach of a great army to Paris, roused the populace to frenzy. The mob rose on the 14th, levelled the Bastile to the ground, massacred every obnoxious person, and committed the greatest excesses. To appease them, Louis was glad to dispatch a courier to Necker, requesting his immediate return. He returned accordingly, was received at the gates of Paris by the acclamations of thousands; his bust was paraded through the streets, and his house emblazoned with the inscription, *Au Ministre adoré.*

This triumph, however, was of short duration. The democratic influence had now gained such an ascendency, that Necker found it utterly impossible to prosecute his favourite objects. The voice of moderation could no more be heard. He was hostile to the extravagant measures, and rash innovations, which were sanctioned by the Assembly, and tumultuously hailed by the populace. In all his proposals he was confronted by the eloquent but insidious Mirabeau,—the man who, devoid of all integrity, and scrupling at no expedient for accomplishing his schemes, contributed, perhaps, more than any other of the revolutionists, to conduct the nation into that state of anarchy which afterwards ensued. At length when Necker submitted the project of a loan, in which a large sum was to be furnished from his own private fortune, Mirabeau seconded the measure, and made it a handle for the production of various accounts before a select committee, who being at once devoted to his views, and ignorant of finance, brought out a report equally injurious and irritating to Necker, and thereby completely overset his declining popularity. He was branded as an aristocrat for having supported the royal *veto* and opposed the destruction of the *noblesse*; his personal safety was endangered; and he felt it was high time to retire. He accordingly set out for Switzerland, leaving his share of the loan, (about L.80,000 Sterling,) and a large portion of his property behind him. On the road he encountered the execrations of those who had lately blessed him, and with difficulty secured himself from their violence. He was indeed once arrested in his journey, and a decree of the National Assembly became necessary for allowing him to proceed.

At Copet, where he now fixed his residence for life, his reflections on the great scenes he had witnessed or shared in produced a languor and disquietude, which objects less grand and imposing were altogether incompetent to remove. He bitterly deplored the state of obscurity and inactivity into which he had fallen, but chiefly the frustration of what had seemed to him the best schemes for securing the honour and happiness of France. When Gibbon, on a visit, proposed some domestic amusements to divert his thoughts from these melancholy broodings, he replied in a tone of deep despair, "In the state in which I am, I can feel nothing but the blast that has overthrown me." Time, however, and the benignant influence of religion, did not fail to mitigate this despondency. He began to collect the scattered elements which yet remained to him of happiness and contentment. Directing his attention to the peaceful pursuits of literature, and his favourite subject, political philosophy, he composed various treatises in support of the doctrines he had held, and endeavoured to vindicate the line of conduct he had followed. In 1794 his domestic comfort was severely assailed by the death of Madame Necker; but an illustrious daughter remained, who regarded him with truly filial affection, and whose brilliant powers it was a delightful occupation to cultivate. She has since been well known to the literary public by the name of Madame de Stael. Watching over his declining age with the tenderest solicitude, she had reluctantly obeyed his parental injunction to recreate and instruct herself by a visit to Germany, when he was seized with his last illness. He died in her absence, on the 9th of April 1804.

The following is a list of his writings, and those of Madame Necker. *Response a Morellet*, 1769. *Eloge de Colbert*, 1773. *Mémoires sur les Administrations Provinciales*, 1781. *Response au Calonne*, 1787. *Le Compte Rendu. Nouveaux Eclaircissemens sur le Compte Rendu*, 1788. *De l'Importance des Opinions Réligieuses*, 1788. *Observations sur l'Avant Propos du Livre Rouge*, 1790. *Sur l'Administration de M. Necker, par lui-meme*, 1791. *De la Révolution Francaise*, 1797, by Madame Necker. *Des Inhumations Precipitées*, 1790. *Mémoir sur l'Establissement des Hospices*, 1794. *Reflexions sur le Divorce*, 1795. And eight volumes of *Mélanges*.

NECROMANCY, a species of divination, which consisted in revealing future events, by a pretended communication with the dead. This superstitious art seems to have had its origin in Egypt at a very early period, whence it was diffused amongst almost all the nations of the world. It is severely condemned in the books of Moses, as "an abomination to the Lord;" but notwithstanding this prohibition, it appears from Saul's edict, and from his own subsequent transaction with the witch of Endor, that necromancy was practised among the Israelites. This superstition prevailed among the Greeks and Romans insomuch that Cicero wrote two books against divination in general. The ancient mode of burying in caves or sepulchres, where the dead were ranged in niches around the sides of the pit, seems to have favoured necromancy, if not occasioned its origin.—These dreary caves became scenes in which the rites of pretending to invocate the ghosts of the dead might be practised with great success, under the awful impression which the presence of the corpses was calculated to produce on the imagination of those who came to consult the necromancers. The sepulchres of the ancients also gave rise to the opinion, that the infernal regions, or abodes of separate spirits, whether in happiness or misery, were under the ground, whence it might be easy to summon them, or whence at least their voice might be emitted. Thus we read in Isaiah, of "speech whispering out of the dust," ch. xxix. 4. The voice or sound is ascribed to the wizzards or adepts themselves, who are said "to peep and mutter," for no where, in scripture, not even in the history of Saul's transactions at Endor, is there the least countenance given to the idea of a power existing with the living over the spirits of the dead. That these spirits uttered a feeble stridulous sound, very different from the natural human voice, was a popular opinion among the heathens, as well as among the Jews. This appears from several passages of the poets, Homer, Virgil, and Horace. The pretenders to necromancy were chiefly women, as they were better fitted than men for giving the expected softness and shrillness to the responses. Or they may have been ventriloquists, as seems probable from the Hebrew word applied to a wizzard or witch, which signifies a bottle or the belly. They had at any rate the art of speaking in a feigned voice, so as to deceive those who consulted them, by making them believe it was the voice of the ghost. See MAGIC and MYSTERIES.

NECROPOLIS, signifies the city of the dead, and was the name given to a suburb of Alexandria in Egypt, probably on account of its superb mausoleums, or rather the numerous catacombs cut in the rocks, and still to be seen in the neighbourhood of the city. Niebuhr and others who have examined these excavations, enteertain no doubt that they were anciently used as tombs.

NEEDLE, a small steel instrument adapted to the purpose of sewing. When the labour employed in the manufacture of this commodity, which constitutes an important article of commerce, is considered, the cheapness of needles is somewhat surprising. The steel employed for the purpose, is first, by fire and hammering, brought into a cylindrical form. It is then, while properly heated, passed through a succession of holes in a wire-drawing iron, each of which holes, from the largest, gradually diminishes in size. To render the steel more manageable, it is usually greased with lard every time it is to be drawn. The fine wire thus formed, is cut according to the size of the needles intended, and each piece is flattened at one end on the anvil. After being softened anew in the fire, these pieces are pierced in the flat end with a puncheon to form the eye, and then laid on a block of lead, that with another puncheon the fragment, which has been separated, may be removed from the eye. The corners of the heads are then rounded a little, and a small cavity is filed on each side of the flat of the head. The point is next formed, and the whole neatly filed over. They are then laid on a long narrow iron over a charcoal fire, and, when properly heated, are thrown into a vessel of cold water. To remove the brittleness occasioned by this operation, and give the proper temper, they are placed on an iron shovel, and again exposed to the fire. On the due regulation of the heat, and the time of exposure to the fire, very much depends. They are then straightened one after another with the hammer, and given over to be polished. To complete the work, a piece of new buckram is sprinkled with fine emery dust: On this twelve or fifteen thousand needles are ranged in small heaps over against one another, emery dust is thrown over them, the mass is sprinkled with olive oil, and the whole made up into a roll well bound at both ends, which is placed under a thick plank of wood loaded with stones, to be wrought backwards and forwards by two men for a day and a-half or two days successively. By this operation, the needles receive a fine polish. This done, they are washed with hot water and soap, then dried in hot bran, after which their points are turned one way and smoothed with an emery stone turned by a wheel. It now only remains to sort them into packets of 250 each. German and Hungarian steel are preferred for the purpose of making needles. Needles are formed of various sizes, from No 1. the largest, to No. 25. the smallest. This branch of manufacture was first introduced into England by a native of India in 1545, but at his death the art was lost. In 1560 it was recovered by Christopher Greening, who settled at Long Crendon in Bucks, where the manufactory is continued to the present day.

NEEDLE, in the mariner's compass, a slender bar of iron, magnetised, and nicely balanced on a pivot, about which it turns freely. For an account of the direction of the needle and its variation, see MAGNETISM.

The shape of the compass needle is a matter of some consideration. Those of merchant vessels were formerly composed of two pieces of steel wire, in the shape of a lengthened lozenge; those of the navy were formed of a single piece of steel, broad at the end, and tapering towards the middle. Both kinds were found to be extremely inaccurate, the latter having six poles instead of two. The experiments of Dr Gowin Knight have determined the best shape to be that of a slender parallelopiped, straight, and square at both ends. In the middle of this bar a perforation is made, over which a brass cup is soldered, with a conical cavity for receiving the pivot, the point of which is exceedingly fine. Polarity may be given either by leisurely stroking it with one magnet, or which is preferable by using two magnets one in each hand, which are drawn from the centre outwards, then raising them to a considerable distance above the needle, and bringing them down perpendicularly again upon the centre. This repeated twenty times is sufficient; the ends of the bar will point to the poles contrary to those which touched them.

The inclinatory or dipping needle is one suspended by its centre, so as to revolve, not horizontally, but in a vertical plane. The north pole will then be depressed so many degrees below the horizon, according to the latitude of the place.

NE EXEAT REGNO, in law, a writ to prevent a person from leaving the kingdom without special licence. It is granted when, on a suit being commenced in the Chancery, the plaintiff apprehends, on some ground or other, that the defendant designs to flee to some other country; and then the defendant must satisfy the court by affidavit or otherwise, that he has no such design, or give security in a large sum to the master of the Rolls.

NEGRO, the name applied to a variety of the human race, who are of an entirely black complexion, and are found in the torrid zone, especially in that part of Africa lying within the tropics.

NEGROLAND, or NIGRITIA, an immense tract of country in the interior of Africa. Though negroes inhabit Guinea and Nubia, and are also found in the Papous Land, or what is called New Guinea, yet the name Negroland or Nigritia, has long been conventionally given to that part of Africa which is bounded by Zaara on the north, by Nubia and Abyssinia on the east, by Guinea on the south, and by the Atlantic ocean on the west. It is occupied by various tribes or nations, who are characterised as gentle and benevolent. They are no longer hunters like the American Indians, but are advancing from the state of shepherds to that more civilized state in which agriculture is prosecuted, and rapid advances are made in arts, manufactures, and commerce. The country is fertile, especially along the rivers, abounding in tropical productions; but Park did not observe the sugar cane, the coffee, nor the cocoa tree. The orange and banana trees seen near the coast, are supposed to have been introduced by the Portuguese. The climate is very warm, but owing to the inequality of the country the heat is seldom excessive. Violent tornadoes accompany the commencement of the rainy season in June, and its termination in November. The harmattan, which blows occasionally during the dry season, is a remarkable wind, accompanied with a fog or haze, which sometimes renders near objects obscure. No dew falls during its continuance, nor is there the least appearance of moisture in the atmosphere; though, when it continues long, tender plants are destroyed, vegetables of every kind are injured, and man himself greatly incommoded by its parching effects. Salubrity is so characteristic of the harmattan, that while it blows the sick speedily recover, infection ceases, and cannot even be communicated by art. Negroland is watered by three of the chief rivers of Africa, the Niger, the Senegal, and the Gambia. Like Guinea it produces gold, which is procured by washing the sand either dug up in some parts of the country, or collected from the beds of streams. It has four principal capes, of which Cape Verd is the first. The Europeans have settlements on the coasts, chiefly about the mouths of the Senegal and Gambia. In this extensive territory is comprehended the country of the Foulahs, Jaloffs, and Feeloops, with the kingdoms of Mandingo, Karta, Bambarra, and Massina. See Park's *Travels*; Leyden's *Discoveries*, by Murray; *and Transactions of the African Association.*

NEGROPONT, the largest island in the Grecian Archipelago, about ninety miles long and twenty-five broad, stretching along the eastern coast of Achaia, and separated from the continent by a strait so narrow near the capital as to admit of a junction

Nehemiah.

with the continent by means of a bridge. The strait was anciently called *Euripus*, and is remarkable for the irregularity of its tides. The island itself is the *Eubœa* of the ancients; and is traversed through its whole length by a ridge of mountains, the summits of which are for a considerable part of the year covered with snow. The vallies and plains are warm and fertile, abounding with grain, wine, oil, and excellent fruits. It is said to contain about 60,000 inhabitants, three-fourths of whom are Greeks. *Negropont*, the capital, is a walled city of considerable strength, with a good harbour. It contains a population of 15,000.

NEHEMIAH, the son of Hachaliah, succeeded Zerubbabel in the government of the Jews. He was born during the captivity, and selected to be royal cup-bearer in the Persian court. Being in high favour with king Artaxerxes, he received a commission to go to Jerusalem, to superintend the rebuilding of the walls of the city, and to set in order the affairs of the Jews. Having presided among them as governor for twelve years, his commission expired, and he returned to Persia, but was afterwards sent back to Judæa, where he died. He was evidently the author of the canonical book of Scripture which bears his name and contains his history.

NELSON, Horatio, Viscount, Duke of Bronte in Sicily, a naval commander who stands hitherto unrivalled, was born, in 1758, at Burnham-Thorpe in Norfolk, of which place his father was rector. He was educated at the school of North Walsham till the age of twelve, when his uncle, Captain Maurice Suckling, took him under his care on board the Raisonable of 64 guns. This vessel being shortly after put out of commission, young Nelson sailed with a merchantman for the West Indies; and on his return he joined his uncle, who had obtained command of the Triumph. Early in the year 1773 he had the gratification of being allowed to accompany the expedition then fitted out by government for a voyage of discovery towards the north pole, and of which the command was entrusted to Captain Phipps. After visiting the frigid he was anxious to explore the torrid zone; and he accordingly was employed in the Sea-horse bound for the East Indies.

Having received a commission as second lieutenant of the Lowestoffe of 32 guns in 1777, Mr Nelson was, two years afterwards, made post-captain, and appointed to the Hinchinbrooke, with which he sailed to the West Indies, and contributed essentially to the reduction of Fort Juan, on the river St John, in the gulph of Mexico. He took the command of the Albemarle in 1781, and passed the ensuing winter on the north seas, after which he was appointed to the Boreas, and ordered to the West Indies.

In 1787 he married the widow of Dr Nisbet, physician of the island of Nevis, and retired for a period to enjoy the sweets of domestic felicity, till the year 1793, when he was called upon to take the command of the Agamemnon of 64 guns, and sailed for the Mediterranean under Lord Hood, who, in the following year, had occasion to bear the most ample

Nepaul.

testimony to his skill and activity in the operations against Bastia and Calvi in the island of Corsica. As a testimony of respect for his brilliant services he was directed by the commander-in-chief to wear a broad pendant as commodore; and he was about the same time removed from his favourite Agamemnon to the Captain of 74 guns. He next distinguished himself by prodigies of enterprising valour in the battle of St Vincent; and having been honoured with the order of the Bath and appointed rear-admiral of the Blue, he was afterwards sent on a desperate expedition against Teneriffe, where he lost his right arm while gallantly signalizing himself at the siege of Santa Cruz in that island. On his return to England, his country voted him a pension of L.1000. The successive victories of the Nile, Copenhagen, and Trafalgar completed the climax of his professional glory. In the battle of the Nile nine French ships of the line were taken and two burned; and before Copenhagen eighteen Danish ships were destroyed, seven of which were of the line: But the last and greatest achievement of this gallant hero was the ever-memorable battle of Trafalgar, in which nineteen sail of the combined French and Spanish fleet were captured, with the French commander-in-chief and two Spanish admirals. He fell towards the close of this sanguinary but victorious conflict in 1805. Our limits do not admit of particularizing minutely the many arduous and important services in which Nelson was actively engaged. His unrivalled services, however, are indissolubly connected with the most splendid æra in the history of his country. (See Britain.)

The remains of Lord Nelson were, with great solemnity, interred in St Paul's church-yard, while the highest honours of a grateful country were conferred upon his memory: Public monuments were decreed, statues and obelisks were enthusiastically reared by most of the principal cities of the British empire, to testify their gratitude and sorrow for the loss which his country had sustained by his death, and to commemorate the matchless glories of his life, which, in the page of faithful history, will never die.

"He cannot be said to have fallen prematurely whose work was done, nor ought he to be lamented who died so full of honours, and at the height of human fame. The most triumphant death is that of the martyr; the most awful that of the martyred patriot; the most splendid that of the hero in the hour of victory: and if the chariot and the horses of fire had been vouchsafed for Nelson's translation, he could scarcely have departed in a brighter blaze of glory. He has left us not, indeed, his mantle of inspiration, but a name and an example which are at this hour inspiring hundreds of the youth of England; a name which is our pride and our example, which will continue to be our shield and our strength." (See Southey's *Life of Nelson.*)

NEOTS, St. a considerable town of Huntingdonshire. See Huntingdonshire.

NEPAUL, an extensive independent sovereignty in India, comprehending nearly the whole of Northern Hindostan. See Hindostan.

NEPHEW, a brother's or sister's son, who, according to canon law, stands in the second degree of consanguinity, but according to civil law in the third.

NEPOS, Cornelius, an eminent Roman biographer, who flourished in the time of Julius Cæsar. According to Catullus, he was born at Hostilia, a town of Verona in Cisalpine Gaul, and if we may credit St Jerome he lived to the sixth year of Augustus. All that remains of the works of Nepos is his *Excellentium Imperatorum Vitae*, which was translated by Claveret into French in 1663, and by M. le Gras at Paris in 1792, 12mo. It has been likewise translated into English.

NEPTUNE, in mythology, the son of Saturn and Vesta, or Ops, and brother of Jupiter, Pluto, and Juno. In the division of the universe, when Jupiter arrived at the supreme power, Neptune was rewarded for past services with the dominion of the sea. He is usually represented in an azure or sea-green robe, with a trident in his hand, seated in a large shell for a chariot, drawn by dolphins or sea-horses, and attended by Glaucus, Thetis, and a long train of tritons and sea-nymphs. His favourite wife was Amphytrite.

NEREIDS, or Nereides, in ancient mythology, sea-nymphs, the daughters of Nereus and Doris. They are usually represented as riding on sea-horses, sometimes in the entire human form, at other times with the tail of a fish. See Andromeda and Perseus.

NESTOR, in fabulous history, the king of Pylos in the Peloponnesus, who led his subjects to the Trojan war. He is reprented by Homer as the most perfect of heroes, and as more valued by Agamemnon than any other of the Grecian generals. What he was chiefly distinguished for was the wisdom of his counsels, the prudence of his measures, and the eloquence with which he was able to recommend them, or to inspire others with fortitude. After the Trojan war, he retired to Greece, and there spent the remainder of his days in tranquillity.

NESTORIANS, a sect of Christians which originated in the fifth century, and derived its name from Nestorius, at that time a Syrian bishop of Constantinople. In consequence of denying that Mary could with propriety be styled "the Mother of God," a favourite epithet in those days, he was charged not with Arianism, or what is now called Socinianism, but with dividing Christ into two persons, and was on this account condemned by the council of Ephesus. He solemnly denied the charge; and many have thought that the controversy was a mere logomachy or misunderstanding, the difference between him and the council being in words only, while they held the same opinion in effect. Of all the promoters of the Nestorian cause, the most famous was Barsumas, bishop of Nisibis. So remarkable was the success of his efforts to establish it in Persia, that his fame extended throughout the east; and in Chaldea, Persia, Assyria, and the adjacent countries, he is still considered as the parent and founder of the sect.

This sect flourished under the Saracens, and in the seventh century introduced Christianity among the Chinese. We find the Nestorians planting the gospel in Tartary, and still extending their pale in the tenth century. In the thirteenth they were frequently solicited by the Romish missionaries to submit to the papal yoke, but in vain. In 1551, however, two factions sprung up among them, and the patriarchate, which had hitherto been single, became divided. A new patriarch was then consecrated by Pope Julius III., and the succeeding patriarchs persevered till the last century in their communion with the church of Rome. They seem now to have withdrawn themselves from it. Their spiritual dominion is very extensive, including a great part of Asia.

NET, a kind of snare for catching fish or fowl. See Fisheries, and likewise Sports and Pastimes.

NETHERLANDS, or Low Countries, a kingdom of Europe, extending over a space of above 24,000 British square miles, of which 13,400 constitute the Belgic territory, and the rest the Dutch. It consists of seventeen provinces, (seven Dutch and ten Belgic,) together with the grand duchy of Luxemburg, and contains a population of 5,226,000, exclusive of the military. These provinces are called the Netherlands, or Low Countries, from their position and general aspect. So variously, however, has the name been used for nearly the last two centuries, that no correct idea of the situation or extent of the Netherlands could easily be formed. Sometimes the southern provinces, called *Belgium*, were so designated, while the seven northern provinces were called the *Dutch Republic*, or *United Provinces*. In the present article we shall give some account of Holland as well as of the provinces called Belgic, as Belgium and the Seven Provinces now form one kingdom, which was constituted so lately as 1814.

*Holland*, the most considerable of the Seven United Provinces, while they existed in the form of a republic, has for its boundaries on the south and west Dutch Brabant and Zealand, and the German ocean, or North sea, and on the north and east the Zuyder Zee and the province of Utrecht, and part of Guelderland. It is divided into South Holland and North Holland, which latter is also called West Friesland, by way of distinction from Friesland on the east side of the Zuyder Zee. In both divisions of this extensive province there are numerous large cities and pleasant villages. The chief places in South Holland are Amsterdam, Rotterdam, the Hague, Leyden, Haerlem, Dort, Delft, &c. Rhineland, so called from the middle branch of the Rhine running through it, is a district of this division, having for its capital Leyden, and within its jurisdiction are 45 considerable boroughs and villages. To South Holland likewise belong the island of Voornless, between the mouths of the river Maese, or Meuse, which, with those of Overslackee and Goree, was anciently part of Zealand, and now constitutes the territory of Voornland; the island of Ruggonhill, east from Voorn, together with that of Finard. The river Wye separates South Holland from North Holland, which has for its chief towns Edam, Saardam, Monikendam, Alcmaer, and Hoorn; and likewise a number of islands attached to it. The greatest extent of Holland from north to south, including the Texel island, which is separated from the north cape of North Holland by a narrow channel, is about 90 miles, and from east to west 25 miles in some places, and above 40 in others.

This country is almost every where lower than the sea, the water being kept out by immense dykes; and hence the name Holland, or *the hollow land.* By the labours of the Dutch, it has been rendered remarkably powerful and populous, considering its small extent; and it thus affords a striking proof of what persevering industry is capable of effecting. The possession of the soil, however, is disputed by the ocean, which, rising above the level of the land, sometimes threatens to overflow it. There being nothing to break the violence of the sea from the islands of Schelling and Vlieland to the shore, the dykes near Medenblick, in North Holland, are necessarily very high and broad. During northerly winds, the water beats with great fury in that quarter, and at spring-tides the sea rises to such a height that the dykes would be overflown and broken down, were not means taken to prevent such a fatality. In these cases, the fury of the waves is repressed by the inhabitants, who lay sails over the dykes to preserve them in a tempest. As the lands frequently require draining, in consequence of the waters of the sea or the rivers breaking in upon them, there are in Holland an immense number of wind-mills for that purpose. Contrary to what might be expected in a country so situated as this, the scenery is extremely interesting. Meadows, gardens, and groves in various directions meet the eye, while a vast number of vessels are constantly seen coming up and down the canals, which branch out not only to all the principal towns, but even to every paltry village. "Nothing can be more agreeable," says Lady Montague, "than travelling in Holland. The whole country appears a large garden; the roads are well paved, shaded on each side with rows of trees, and bordered with large canals full of boats passing and repassing. Every twenty paces give the traveller the prospect of some villa, and every four hours that of a large town surprisingly neat."

This country abounds very much in pastures, so that the produce of cattle, butter, and cheese, is exceedingly plentiful; and a great supply of fish is obtained from the seas and rivers. It has a cold and humid climate, and the east wind blows fiercely nearly all the winter. The soil of Holland being alluvial, is unusually rich, but comparatively little land is under tillage. Wheat, madder, hemp, flax, and clover constitute the principal crops. The breed of cattle is the Holstein or Danish, and the horses are chiefly from Flanders or England. In 1804, when the number of horses, sheep, and swine was said to be rather on the decrease, there were in this province 902,526 horned cattle, of which 252,394 were under two years of age. Bees, on account of their wax, are in some parts an object of great attention. The quantity of wax gathered every year is very considerable, and the bleaching of it affords occupation to the humbler classes. At one period, as is well known, the passion for flowers, especially tulips, had arrived at an amazing pitch in Holland; but it latterly diminished, in consequence of the judicious interference of the legislature.

Holland enjoys a great variety of manufactures and merchandise, and may be considered a kind of magazine for the productions of all countries, the inhabitants purchasing them remarkably cheap, and not unfrequently selling out at a high price even to the same countries from which they were bought. Among the principal manufactures are linen and woollen stuffs, paper, earthen ware, glass, pipes, and cordage. There are likewise a considerable number of breweries and distilleries, numerous saw-mills, especially in the neighbourhood of Rotterdam, and several oil-mills. Prior to the French revolution, the commerce of Holland was in a most flourishing condition; but it suffered very severely from that event. By the canals and the Rhine a thriving inland trade is carried on with Germany, the most striking feature of which is the immense floats of timber which regularly arrive at Dort from Andernach and other places on the Rhine, and produce vast sums of money. Through the medium of Holland, about one million pounds of silk were in the year 1807 imported into England from Italy.

This province is remarkably populous. According to an estimate drawn up in 1796 by order of the National Assembly, the population of Holland was 828,542, while that of the United Provinces amounted in whole to 1,830,463. The following are the particulars of the entire population of the provinces, according to the estimate alluded to: Guelderland 217,828; Holland 828,542; Zealand 82,212; Utrecht 92,904; Friesland 161,513; Overyssel 135,060; Groningen 114,555; the country of Drent 89,672; Dutch Brabant 208,177.

The Hollanders are characterised as affable, industrious, laborious, absorbed in trade, excellent sailors, moderate politicians, and lovers of liberty. Calvinism is the prevailing religion amongst them, but perfect toleration is allowed to all persuasions. These people are peculiarly disposed to cleanliness, and their houses have in general a gay appearance, the doors and windows being commonly painted of a green colour. So prevalent is the practice of smoking in Holland, that the Dutch boors, instead of calculating the distances of places by miles, have a custom of marking how many pipes are smoked in going from one place to another; thus, from Rotterdam to Delft four pipes, or onward to the Hague seven pipes. The Dutch language, which appears to be of Gothic origin, is but little known out of the United Provinces.

In 1795, the taxes of the province of Holland amounted to no less than 24,000,000 of guilders, or L.2,000,000 Sterling. But although the taxes are thus very heavy, a considerable portion of it is paid by foreigners, who make use of the commodities taxed.

Holland was anciently inhabited by the Batavians, who derived their origin from the Catti, a people of Germany. Originally they established themselves in an island formed by the waters of the Rhine and Wahal or Leck, and named their country Batavia, or Betuwe, from Batton, the son of their sovereign. The history of the United Provinces is intimately connected with that of the Netherlands.

*Belgium*, the southern part of the Netherlands, comprising the ten Catholic provinces, extends from 2° 30′ to 6° 58′ east longitude, and from 49° 30′ to 51° 40′ north latitude, and is bounded on the north by Holland and the German ocean, on the south and west by France, and on the east by the Prussian duchy of the Lower Rhine. Its greatest length is about 180 British miles, and its medium breadth 120, forming a superficial area of 13,400 square miles.

Except some small hills in the counties of Namur and Luxemburg, the surface of the country is uninterrupted. Compared, indeed, with other regions of Europe, Belgium has remarkably little to adorn or diversify its aspect. In the midst of this monotony, however, the eye is somewhat relieved with the prospect of corn fields and extensive meadows of the freshest verdure covered with numerous herds of cattle, while the number of barks passing and repassing on the canals, and the close succession of farms, villages, and towns, at once indicate the industry and wealth of the country. From the top of any tower or steeple, the only elevation commanding an extended view, may be beheld a vast space of fertile and well cultivated land, studded with villages and towns in all directions, and intersected with many canals.

The climate of this part of the continent is not unlike that of the south of England;—the soil, which is of a sandy nature, is much more dry than that of Holland. There is a similarity in the vegetable productions, as well as in the climate of England and Belgium. This country has vied with Lombardy for six centuries, and for a shorter period with Britain, in meriting the appellation of *the garden of Europe*. Abundance of grain is produced in the provinces nearest France, as well as vegetables, fruits, hemp, and flax; but wood is scarce. The wool of Belgium is of good quality, having been improved by the mixture of a breed imported from India, and its cattle and horses are remarkable for size and strength. It contains some valuable strata of coal, which were long neglected, but are now wrought to advantage; and likewise mines of iron, lead, copper, calamine, and zinc. The rivers, lakes, and coasts abound with fish.

None of the rivers of Belgium is of great length. In point of scenery, the Meuse is the most interesting, being much superior to the Scheldt; which latter river deepens and widens very considerably by the resistance of the sea. These rivers, together with their subsidiary streams, and the canals which connect them with each other, and with the Rhine, are of the greatest advantage to inland commerce, by affording an easy and safe navigation, not only to all parts of the kingdom, but to the west of Germany, the north of France, and even to Switzerland.

In the multitude of its towns and villages, many of which are fortified, is still discernible the ancient splendour of the southern provinces. Except on the borders of the river Meuse, where the ground contains marble and stone, the houses are uniformly built of brick, with steep roofs, the ends of which are directed to the street, and the general appearance of the towns and villages is not a little agreeable. Brussels (already noticed in the order of the alphabet) is the principal city of Brabant, indeed of Belgium, and, alternately with the Hague, it is the seat of the parliament of the new kingdom.

*History.*—The first account we have of the Netherlands, is that of their subjugation by the Romans. The opposition they made to the arms of that powerful people was vain, as also their spirited attempts to throw off the yoke during the reign of Vespasian; but so highly was their value estimated by their conquerors, that for many years the body-guard of the Roman emperors was chosen from among the Batavians. For four centuries prior to the time of Honorius, we find Batavians enumerated among the Roman armies, but their names afterwards disappear from history. By the eruption of the northern nations, which in its course swept over their country, all the monuments of the Romans were devoted to destruction. In the sixth and seventh centuries, the monarchy of the Franks, which arose from the ruins of Gaul, had embraced all the provinces of the Netherlands, and planted in them the faith of Christianity. The whole of those countries were united by Charlemagne with the extended empire he had formed out of France, Germany, and Lombardy. After this, the Netherlands became at one period provinces of Germany, at another of France, and they were at length distinguished by the names of Friesland and Lower Lorraine. Owing to concurring circumstances, the Netherlands were in the tenth and three succeeding centuries divided into a number of petty sovereignties. By means of purchase, conquest, or inheritance, one master was not unfrequently at the head of several of these petty states; and, indeed, they were almost all of them possessed by the house of Burgundy in the 15th century. The last king of Burgundy, namely, Charles the Bold, being killed by the Swiss in 1477, his part of the Netherlands devolved on Mary, his only child, by whose marriage with the Emperor Maximilian the Netherlands became united to the Austrian territories. In 1556, the sovereignty of the Netherlands was abdicated by Charles V.; and not long after the Spanish crown, in favour of his son Philip. The diabolical tyranny of Philip II., with the barbarities exercised by the Duke of Alva, induced the inhabitants to attempt throwing off the Spanish yoke, and a general insurrection ensued. Under the conduct of William I. Prince of Orange, they formed the famous league of Utrecht in the year 1579, which proved the foundation of the republic of the United Provinces, namely, Holland, Guelderland, Zealand, Utrecht, Friesland, Overyssel, and Groningen. From this period to 1795, the United Provinces might be considered as one political body connected for the preservation of the whole. They guaranteed each others rights, they made war and peace, levied taxes, &c. in their joint capacity, but each province was independent as to internal government. Deputies were sent by the United Provinces to the General Assembly, called the States-general, which was invested with the supreme legislative power of the confederation. There has been usually at the head of this government a prince or stadtholder, by whom was exercised a great part of the executive power.

The new republic had comparatively limited resources, and but for the madness and folly of Philip, who failed not to take part in every political transaction of Europe, might scarcely have survived its infancy. The Hollanders, however, though a poor, were an industrious and a commercial people; and with William at their head, they, by no means, gave themselves to despair. But Philip, well aware of the importance of such a prince to the confederacy, after, in vain, endeavouring to gain him over by gifts and fair promises, at length set a price on the head of William; and he was, in consequence, assassinated by Balthazar Gerard, at Delft, in 1584. The death of this prince was a severe blow to his fellow-citizens, while, at same time, it rendered their hatred to Philip more implacable. Elizabeth of England, though she more than once rejected the offer of the sovereignty of the Netherlands, had been induced to lend them assistance secretly, and their quarrel was now openly espoused by her. She sent them an army, which, with the forces of the republic, was placed under the command of Maurice, the late prince's son, a young man of extraordinary talents, and who had, by a grateful country, been elevated to the rank of governor. Philip II. not long after this, finished his restless career; and after an obstinate war and a truce of twelve years, Spain at length acknowledged the independence of the United Provinces, by the treaty of Westphalia in 1648. While by the termination of this contest the freedom of the Seven Provinces was established, the chains of the other ten were rivetted namely, Brabant, Malines, Antwerp, Namur, Limburg, Hainault, Luxemburg, Flanders, Artois, and Cambresis. The history of the Netherlands after this contest, presents almost nothing of equal importance.

In 1652 the States ventured to engage in a naval contest with England, which was, ere long, terminated in consequence of the death of their brave admiral Van Tromp. In 1668, the Dutch republic experienced a still more severe trial. Profiting by the inability of Spain, Louis XIV. of France had led an army into the Low Countries, and was rapidly extending his dominions, when his ambitious career was checked by the Triple Alliance concluded in 1669 at the Hague. Louis, who was supported by the ministry of our Charles II. determined to punish the Hollanders for the share taken by them in this transaction, and accordingly crossed the Rhine in 1672 with a vast army. To oppose an army of 130,000 veterans led on by Condé, Turenne, and Vauban, the Dutch had only a few raw troops, headed by a general scarcely arrived at manhood; the country was consequently, in a short time, overrun by Louis, and not many weeks had elapsed when Amsterdam remained the only asylum of Dutch liberty. In this dilemma, the States, preferring independence to every other consideration, opened the sluices of their sea-dykes, inundated the country, and thus compelled the French troops to retire with the utmost precipitation. The Dutch now, in their turn, became the aggressors, and, with their young prince at their head, carried on the contest till the year 1679, when it was concluded to their satisfaction.

By the peace of Utrecht, Belgium was consigned to the throne of England, and Holland remained in peace till 1740, when it was once more threatened with all the miseries of foreign invasion, in consequence of having espoused the cause of Maria Theresa, whose title to the imperial throne had been disputed. Louis XV. had, during the contest, found his way into the Netherlands; and Maréchal de Saxe, after having conquered Belgium for him, made an attack on Holland. The arms of this general were remarkably successful against the Dutch, but, fortunately for them, hostilities were terminated by the treaty of Aix-la-Chapelle in 1748, which gave Belgium to Austria, while it occasioned the deliverance of Holland. Owing to the numerous wars and conquests which flowed from the revolution in France, the whole of the Netherlands have undergone considerable changes. Holland was, however, at length freed, in 1814, from its oppressors, by means of the successes of the allied sovereigns. The whole seventeen provinces were united into the kingdom of the Netherlands, and the prince of Orange ascended the throne, which he has since possessed in peace.

In the Netherlands the form of government is not unlike that of Britain, though it has several distinctive features, especially that of the existence of provincial states, who superintend the execution of the laws in their several districts, take charge of the public works, and likewise elect the members of the lower house of parliament,—the States themselves being filled up by the people. The members of this lower house, who are 110 in number, accept a petty salary of L220; they cannot originate any motion, and they have no great influence. The Belgic peers can, no more than the commons, bring in any bill on their own authority. They are from 40 to 60 in number, are nominated by the king for life, and accept of an allowance of L.270. By judges chosen *ad vitam aut culpâm*, a system of laws is administered; the press is free, and the taxes are not more heavy than is really required.

The annual revenue of the Netherlands scarcely exceeds seven millions Sterling, and the expenditure is fully equal to it. The navy, though at a former period very powerful, now consists of only 12 ships of the line, with 24 frigates. This, and the military establishment, consisting of 50,000 regular troops, cost L.2,500,000 a year. To the kingdom belong a number of colonies in different quarters of the world, none of which, however, are at present in a very flourishing condition. In Asia, there are Java, Amboyna, Malacca, Ternate, Macassar, and some small settlements on the coasts of Coromandel and Persia; in Africa, 13 small forts on the Guinea coast; in the West Indies, Surinam on the mainland, Curaçoa, St Eustatius, and St Martin.

The government of the Netherlands extends its protection to the ministers of all persuasions of religion, and the followers of every sect are eligible to all offices in the state, so that, properly speaking, there is no established religion in the kingdom. The followers of the Catholic creed, in the whole Netherlands, outnumber the Protestants in more than the proportion of two to one; but Calvinism prevails in the northern provinces, and the court is of the Calvinistic persuasion. Education is very liberally provided for in every part of this kingdom; and to complete the system, a university is established at each of the following cities,—Leyden, Utrecht, Groningen, Louvain, Ghent, and Liege. But, with all its advantages in regard to education, the Netherlands cannot be considered as an intellectual country. The faculties of the people are, however, by no means defective. Holland has given birth to very distinguished names, both in natural and moral science, while the southern provinces are celebrated for great painters. The telescope and the art of printing are inventions of the Dutch. See Sir William's Temple's *Observations on the Netherlands; A Tour through the Batavian Republic in* 1800, by R. Fell; Watson's *Histories of Philip II.* and of *Philip III.*; Mitchell's *Travels in Belgium*, and Boyce's *Belgium Traveller.*

NEUCHATEL, or NEUFCHATEL, a canton of Switzerland, bounded on the east and south by the cantons of Bern and Friburg, on the west by the Franche Compté, and on the north by the bishopric of Basle. The principality of Neuchatel and Vallengin extends from the lake of Neuchatel to the borders of Franche Compté, being 36 miles in length, and about 18 in breadth. It is a mountainous country, watered by several lakes and rivers. The soil is not very productive, but the air is pure and salubrious. In the lower and sheltered parts there are large vineyards that produce excellent wine, which indeed constitutes the chief article of export. Considerable herds of cattle are pastured on the mountains, and deer abound in the forests. The inhabitants, amounting to about 40,000, are chiefly Protestants. From the death of the duchess of Nemours in 1707, the state, for an hundred years, acknowledged the claims of Prussia to the sovereignty. In 1807 it was ceded to France, and given by Bonaparte to Berthier. On the abdication of Bonaparte, the congress of Vienna acknowledged it a Swiss canton, but recognised, at the same time, the nominal sovereignty of Prussia. The lake of Neuchatel is about twenty miles in length, and four in breadth. Its waters flow through the lake of Bienne into the Aar, and finally into the Rhine.

*Neuchatel*, the capital of the above principality, is situated partly on an eminence and partly on a plain, between Mount Jura and the lake of Neuchatel. It consists of four principal streets, which are kept remarkably clean, and the houses in general are well built. Among the principal public buildings are the town-house, a splendid structure, having a pediment in front, supported by eight Ionic columns, and the cathedral church, which latter was erected by the wife of Count Ulrich of Vinelz in 1164. Neuchatel owes much of its present prosperity to the munificence of Mr D. Pury, a worthy citizen, who, at his death in 1786, bequeathed the whole of his large fortune to the improvement of his native city. The promenades on the banks of the lake are fine, and the more elevated houses command magnificent views of the western ridge of the Alps, across the lake. The manufactures are chiefly printed cottons and linens.

NEVERS, a town of France, principal place of the department of the Nievre, and lately a bishop's see, stands on the declivity of a hill by the river Loire, at the influx of the Nievre. Of the public buildings, the most remarkable are the ancient ducal palace, in which John Casimir, king of Poland, died in 1672, the cathedral church, which is a magnificent Gothic edifice, and the church of St. Peter's. The boasted manufactory of enamel, at this place, is merely the blowing of glass with the blow-pipe. Besides works of enamel, the chief manufactures are china and glass, and in the neighbourhood there is a foundery of cannon. Population 10,150.

NEVIS, one of the Carribbee islands, divided by a narrow channel from the east end of St. Christophers, is about eight leagues in circumference. It has but one mountain, which rises in the middle, and is covered to the top with large trees; and it contains about 4000 acres of productive land. This beautiful little island is divided into five parishes—, and Charlestown, on the north-west side, is the capital and the port of entry. Sugar is the only staple production in Nevis. The population, including the whites, who amount to about 600, is estimated at 10,600.

NEUMANN, GASPER, M. D. an eminent chemist, born in 1683 at Zullichau in the duchy of Crossen, Brandenburg, and died at Berlin in 1737. His father, who was an apothecary, brought him up to the same profession, and young Neumann removed to Berlin in 1705, where he engaged in the service of the king of Prussia, who, some years afterwards, allowed him to study at the university of Halle, and then to travel for the purpose of acquiring chemical knowledge. He, in 1711, visited the mines of Germany, and thence passed into Holland. From Holland he went to England, where, in 1713, he was mortified to hear of the death of his sovereign. Neumann accompanied George I. of England to Hanover in 1716. Repairing next to Berlin, he procured an order to resume his travels at the expense of the court, and accordingly visited France and Italy, where he formed connexions with men of eminence. On his return to Berlin he was honoured with the appointment of court-apothecary; and, in 1723, he was chosen professor of chemistry. From Halle he received the degree of M.D. in 1727, about which period he travelled through Silicea and Moravia to Vienna, returning by Bohemia and the mining country of Saxony. Different learned bodies of Europe were now proud to receive him among their members; and he became associated with the Royal society of London, the Imperial academy Naturæ Curiosorum, and the Institute of Bologna. He made a tour to the New Marche and Pomerania in 1734, and discovered the true origin of Ostescollo; and two years afterwards he was nominated dean of the college of Berlin. During his lifetime Dr Neumann published various works, consisting chiefly of dissertations in the Latin language;

and after his death his *Chemical Lectures* were given to the public, of which an excellent English translation has been made by Dr Lewis, in two volumes, 8vo. Respecting the *Chemical Lectures* of Dr Neumann, which Dr Lewis characterises as " a valuable magazine of chemical knowledge," it may be remarked, that, notwithstanding the great modern changes in chemical theory, such a work must still be highly appreciated.

NEWARK, a borough and market town in the county of Nottingham, seated on the Trent, over which there is a bridge. The houses, which are well built, are ranged in two parallel streets, extending nearly east and west, and crossed by two others. Of the public buildings the principal are the church, the town-hall, and the castle. Newark contains about 7200 inhabitants, and has a good trade in corn, malt, wool, and limestone. Cotton and malt are the only manufactures. The church of this town is a magnificent edifice, and was erected in the time of Henry VI. The castle, though now in ruins, is worthy of notice, as it presents a very fine appearance.

NEWBURY, a market town on the river Kennet in Berkshire. It has three spacious streets and an elegant town-hall, erected over the market-place. This town was, for several centuries, famous for the manufacture of broad-cloth. John Winchcombe, who employed an hundred looms in his own premises, assisted the king with all his men in the expedition against Scotland, which terminated in the battle of Flodden. Newbury still carries on manufactures of shaloons, druggets, &c. By the navigable canal to Reading, the trade of the place has been much increased. The population in 1811 was 4275.

NEWCASTLE-UNDER-LINE, a borough and market town in Staffordshire, situated on a branch of the Trent. It derived its name from a castle which stood two miles off at Chesterton-under-Line. The principal street is spacious and well paved, and many of the houses have a fine appearance. Around the town are extensive beds of potters' clay; and the potteries and glass-works in the neighbourhood are very considerable. In the town itself hats constitute the chief manufacture. It formerly contained four churches, but now there is only one, which has a chime of eighteen bells. Here are various dissenting meeting-houses, and twenty alms-houses. This town is governed by a mayor, two justices, two bailiffs, and twenty-four common-councilmen. It returns two members to Parliament. In 1811 the population was 6175.

NEWCASTLE-UPON-TYNE, an extensive, wealthy, and populous sea-port town, which, including a small rural district, is itself a county; and its chief suburb, *Gateshead*, is in the county-palatine of Durham. It is situated on the north bank of the river Tyne, over which there is a bridge, and is nearly two miles in length, and about a mile and a half in breadth. It evidently was a Roman military station, as appears from its position upon the wall usually termed that of Severus, and at the east end of Hadrian's Vallum, as well as from many other discovered Roman remains. Hadrian's Patronymic, *Ælius*, and the bridge erected here, in all probability by him, are supposed to have given to the place the Roman name of *Pons Ælii*. In the time of the Saxons it was called *Moncaster*, from the monks here, who all fled when the Danes depopulated it; and afterwards Newcastle, from a castle built, in 1080, by Robert, surnamed Curthose, son of William the Conqueror, to defend the country against the invasions of the Scots. This castle is now in ruins; but a large square tower, lofty and rich in remains of Anglo-Norman architecture and sculpture, is still in a state of preservation. It is supposed, on good grounds, that the town was defended by a wall prior to the time of Edward I. At all events, those walls and gates, of which remains yet exist, were begun to be built in the reign of that monarch. For strength and beauty these walls were much celebrated; and exclusive of water and other posterns, they contained seven gates. Fifty-five towers of different dimensions added to their strength; and as there were three more strong gates on Tyne-bridge, Newcastle must have been fortified very powerfully. So recently as the year 1745 the fortifications were thought tenable, and would perhaps have opposed a resistance to the progress of Charles Edward had his followers appeared before them.

The situation of Newcastle is agreeable, and on the whole favourable for trade; but the ground on which it stands rises so rapidly from the river as to give an inconvenient steepness to several of the principal streets. Much of the town, however, is built nearly on a level, and considerable improvements have been made, of late years, in opening new avenues for the convenience of the inhabitants. The streets are well paved and flagged, and in winter well lighted with gas. Several of them are remarkably spacious; and Dean street, in particular, contains many elegant and fashionable shops. The houses in all the leading streets are chiefly constructed of brick, and are, for the most part, substantial and lofty. Newcastle is an open, cheerful, and beautiful town; and it is well secured against damage by fire, as appears from the numerous notices upon its walls indicating the vicinity of fire-plugs. Indeed, if this town merited, in the days of Camden, the appellation, " Glory of all the Towns in the North," it now merits still more the title, not unfrequently conferred on it, of " Emporium and capital of the North."

There are numerous public buildings in Newcastle, many of which merit particular notice. The parish church of St Nicholas, which is the mother church, is a venerable edifice, with a lofty steeple of curious architecture,—at once the chief feature of the building and the great architectural ornament of the town. The churches of St John and St Andrew, situated, the former on the north-eastern side of Westgate street, and the latter just within Newgate, are handsome stone buildings, both of ancient origin, and having embattled western towers. The present church of All-Saints, which stands east of that of St Nicholas, is a splendid modern pile, which was erected in pursuance of an act of Parliament passed in 1723, and is said to have cost more than L.27,000. The church of St Mary, Gateshead, is an ancient building, situated on the left of the ascent into Upper Gateshead.

There are about twenty meeting-houses for Roman Catholics, Methodists, members of the church of Scotland and of the United Secession church, Baptists, Independents, Friends, Glassites, Unitarians, &c. The Exchange is a substantial fabric, cased with free-stone, and which comprehends likewise the town-court or guildhall, wherein are held the assizes and various public offices. The Mansion-house is a large and not unhandsome fabric, in which, during the assizes, his Majesty's judges are entertained at the cost of the mayor and corporation. The new court-houses for *the county of Northumberland,* (the assizes for which are always held at Newcastle,) were begun in the year 1810, and the duke of Northumberland gave the handsome sum of L.3000 towards their erection. This superb edifice stands near the brow of the hill on which yet appear the remains of that proud fortress from which the city derives its present appellation. Besides the buildings now mentioned, Newcastle contains a custom-house, an assembly-house, within which is a subscription news-room, with an attached library, and a theatre-royal. One of the gates of this city, yet standing, called *Newgate,* serves as the town jail; and a large mansion, yet remaining, situated near the head of Pilgrim street, is worthy of notice on account of its having been for some time the residence of Charles I. after he had surrendered to the Scottish army.

The benevolent institutions in this opulent city are numerous. The principal of them are a general infirmary, a house of recovery for such as are afflicted with contagious diseases, a lying-in hospital, a lunatic asylum for the counties of Durham, Newcastle, and Northumberland; the Keelmen's hospital, which is supported by the *keelmen,* as they are called, who navigate the Tyne in flat boats, or lighters, called *keels,* wherein coals are carried to the shipping; and a Trinity-house of very ancient foundation.

This town contains various literary institutions, especially a Literary and Philosophical society, with its attached scion, denominated the New Institution, its library, and its valuable apparatus for the experimental part of lectures which are delivered regularly in its hall, and an Antiquarian society, instituted in 1813, under the patronage of the duke of Northumberland. Among the establishments for education in Newcastle, are several grammar schools, the Royal Jubilee Lancastrian school, so named in honour of his late Majesty's entrance into the 50th year of his reign, a national or Bellean school, five parochial charity schools, and various Sunday schools.

The number of printing-offices in Newcastle is 11, and three of these issue newspapers. Newcastle, with its dependencies, contains a population of 50,000, and of this number about 13,000 are supposed to belong to Gateshead. It is governed by a mayor, recorder, sheriff, 10 aldermen, 24 common councillors, &c. The inhabitants are chiefly occupied in the manufacture of glass, especially the finer kinds; fine and coarse earthen ware, soap, cloth, hard-ware, tin-plate, brass and iron-wire, patent shot, &c. Of the iron founderies, which are eleven in number, three are in Gateshead, and attached to one of these is a manufactory of anchor and chain cables. Ship-building is likewise carried on to a considerable extent, the yards for the purpose being five in number. There are eight public breweries, besides two in Gateshead.

The trade in coal to London and other places, which has been carried on for centuries, is the source of much opulence to Newcastle. (See COLLIERY.) Many other branches of commerce have been founded on the basis of the coal trade. A direct importation of corn, wine, fruit, flax, timber, iron, &c. takes place to a great extent, while the chief imports, besides coal, are lead from the mines of Weardale, grind-stones, glass, potters' ware, cast and wrought iron goods, paint, and drugs; salt, butter, and salmon fresh and killed. Above 800 ships, at present, belong to the port, several of which are employed in the northern whale-fishery. To a commerce so extended, three highly respectable banks, exclusive of branches of the Sunderland and Shields ones, afford facilities. All around Newcastle the roads are good, while the public conveyances are eligible and numerous.

Horse-races of considerable note are held annually on Newcastle Moor, north-east of the town. See *Beauties of England and Wales,* Brand's *History and Antiquities of Newcastle,* and Bourne's *Newcastle.*

NEW ENGLAND. See ENGLAND, NEW.

NEW FOREST, a forest abounding with deer, in Hampshire, lying between Southampton water and the river Avon, is 20 miles in length, and 15 in breadth, comprising an area of 92,365 statute acres. It is very advantageously situated with respect to conveyance by water-carriage, and vicinity to the dock-yards. A tract at least 40 miles in compass, and containing many towns and villages, together with 36 churches, was laid waste to make room for the animals of the chase, by William the Conqueror. That tyrannical monarch having dispossessed the natives of their lands and habitations, to convert the district into a hunting ground, the death of his two sons, William Rufus and Richard, and his grandson, Henry, within its boundaries, was believed, by the superstitious of that age, to be a punishment for that oppressive measure. One of these, Henry, being, like Absalom, caught in the boughs by the hair, perished with hunger. William Rufus was accidentally killed by a French gentleman, Walter Tyrrel, who was hunting with him, and whose arrow unfortunately glanced against a tree and struck the prince through the heart. Richard is said to have been killed by a stag or a pestilential blast. As this forest lay for many ages open and exposed to invasions from foreigners, some castles were built in it by Henry VIII., and it is now enlivened with a few small towns and villages. It is divided into nine walks, or districts, to every one of which there is a keeper, under a lord-warden, besides two rangers and a bow-bearer. The lord-warden is appointed during the king's pleasure, and all the courts of jurisdiction are held at Lyndhurst, a village of Hampshire, situated eight miles W. S. W. from Southampton.

In passing through New Forest, it is interesting to witness the foresters browsing the deer. Some hundreds of these beautiful animals may sometimes be seen bounding towards their feeder at his well known signal, and following him for the tender branches he has cut for their repast.

NEW HAMPSHIRE. See Hampshire, New.

NEW HOLLAND. See Holland, New.

NEWFOUNDLAND, a large island on the east coast of North America, lying on the east side of the gulf of St Lawrence, and separated from the coast of Labrador by the strait of Bellisle. Its form is triangular, the greatest length 381 miles, the breadth from 40 to 287, and the circumference 900.

*Aspect.*—The coast is high and remarkably bold. The whole circuit of the shore is indented with well sheltered harbours and bays, which have a smooth bottom, and usually a rivulet of pure water at the head. By these indentations the island may be penetrated to a considerable extent in all parts. The interior is hilly and mountainous; but instead of stretching out in ridges, the mountains are generally of a pyramidal form. So far as the country has been explored, its appearance is dreary and desolate, the levels abounding in small lakes and morasses, with a considerable number of what, in America, are called dry barrens, while the hills are scantily covered with hazels, birches, spruce firs, and pines.

*Climate.*—In winter the cold is extremely severe; all the bays and harbours being frozen, the island is rendered inaccessible to vessels, the whole country is enveloped in fogs and tempests of sleet and snow, and the breezes are often loaded with icy spiculæ which penetrate the smallest crevices. A Newfoundland winter, however, in the absence of these tempests, is not without its beauties. The moon and stars shine with a lustre unknown in Europe, and during the calm frost the northern lights present a most brilliant appearance. The ice generally begins to thaw in April, when the snow rapidly melting both from above and below, impetuous torrents descend from every point to the sea, and these, with the masses of ice which arrive from the north, and are driven about in tremendous agitation, produce an almost indescribable scene of commotion around the island. Summer, without any thing resembling our delightful prelude of spring, comes in with suffocating heat about the end of May. By the middle of August the air becomes temperate, and this is the most pleasant season of the year. Before the end of October the fogs steadily resume their empire, and announce the approach of winter.

*Natural history.*—Bears, otters, beavers, and red foxes, seem to be natives of the island, and are hunted for their skins. Goats, which are numerous, afford the chief supply of milk; and herds of deer are hunted for food. Some cattle kept by the inhabitants are allowed to roam at large, during summer, in the woods. The Newfoundland dog, which is web-footed, and well known for his aquatic powers and great sagacity, is a peculiar species, allied to the Greenland dog, and not, as some have supposed, the mongrel of a wolf and the European dog. He is frequently used in his own country as a beast of draught. The soil and climate of this island are both unfavourable to the growth of useful plants, and the timber is neither abundant nor valuable. Some kitchen vegetables are raised, and potatoes are successfully cultivated; but these, together with strawberries and raspberries, are almost all the native vegetable productions. Grain, and other necessary provisions are imported from Great Britain and North America. No minerals worthy of notice have been discovered here, though coal is supposed to exist in considerable quantities. In the productions of its waters the most valuable mine of Newfoundland consists, and indeed the main inducement to visit this island is the abundance of fish on its coasts. The great fishing bank lying to the south of the island is about 400 miles in length, and 200 in breadth. An account of the fisheries has already been given. (See Fisheries.) At present the fisheries and trade of Newfoundland are supposed to produce an annual income of about two millions sterling.

*Towns.*—The whole island is almost desert, except the settlements of the British; and formerly only a few poor families used to pass the winter upon it. But the number of wealthy citizens has for a long period been increasing, and the villages now begin to assume the appearance of flourishing colonial towns. St John's, the principal settlement, Placentia, and Harbour-Grace, in Conception-bay, are all in the south-east position of the island. *St John's* is fortified with several batteries, is a place of considerable strength, and has one of the finest harbours of the island. The town, some of the newer parts of which are said to have an elegant appearance, is built of wood, so that the houses are very liable to suffer from fire. A printing press being established here, a weekly newspaper issues from it. *Placentia* and *Harbour-Grace* are both very inferior to St John's.

*Inhabitants.*—Among the wealthier inhabitants of Newfoundland, refinement of manners, as might be expected in such a situation, is rarely to be met with. But trade is prosecuted with address and dexterity. Irish, or descendants of Irish, in a great part constitute the poor class. While these, with seeming contentedness, submit to many privations, they are frequently irregular, and even barbarous in their way of life. They are addicted to theft; and among other national festivals observed by them, that of St Patrick's day is kept with riotous jollity. In Newfoundland the circle of enjoyment is very limited. Throughout the summer the people labour amid heat, mosquitoes, and moisture, and during winter they are but imperfectly sheltered from the severities of the season. This island affords no constant store of food to its inhabitants, except fish and potatoes. All the bread used is brought from Britain or America, and a kind of beer made from the twigs of the spruce fir is the only native beverage of the inhabitants.

*History.*—This island was discovered, in 1497, by John Cabot, (Giovanni Gabota) in an English squadron fitted out by Henry VII. It was formally taken possession of in 1583 by Sir Humphrey Gilbert, in the name of Queen Elizabeth. The first permanent colony worthy of the name in this island was planted in 1623 by Sir George Calvert, afterwards Lord Baltimore. About the close of the 17th century the colonists were distressed by the neighbourhood of a rival. A fort having been erected by the French at Placentia, the jealousy which was excited by the competition, and the contiguity of the pursuits of the settlers broke out in frequent broils, although the two nations were then at peace. But after many harrassing disputes, the island was ceded to the British by the treaty of Utrecht in 1713. The French finally evacuated the island, but retained permission to fish on a particular part of its shores, as well as liberty to occupy the islets of St Pierre and Miquelon, with a small garrison, where the fish might be dried. At the peace of Paris (1763) they were thankful again to possess this privilege, after the final conquest of all their colonies in the seven years war. No farther pretensions were then advanced by the French; and this humble one, which, at the conclusion of the late hostilities, was again admitted, constitutes their sole connection with Newfoundland. To the United States a similar right was likewise guaranteed. In 1728 the colonists were favoured with a resident governor; civil and justiciary courts were soon after instituted among them; and in 1792 the addition was made of a supreme court. St John's is the seat of the governor, whose authority also extends over Anticosti, some smaller islands, and the adjacent coast of Labrador.

NEWMARKET, a town of England, situated in the counties of Cambridge and Suffolk, has been long celebrated for the horse-races which are held there in April, July, and October. The course is the finest in England. In 1683, while the king, queen, and duke of York were attending the races, the town was almost destroyed by fire. It suffered by a similar calamity about the commencement of last century. Newmarket consists of one long wide and well built street of houses, and contains upwards of 1,900 inhabitants.

NEW ORLEANS, a city in the province of Louisiana. See Orleans, New.

NEWPORT, the chief town in the isle of Wight. See Hampshire.

NEWSPAPERS, periodical publications, originally designed to circulate extensively information concerning occurrences which might be deemed interesting to the public, but afterwards devoted to political and also to literary purposes. They are powerful engines of public opinion. The first newspaper was published in England, August 22, 1642. The oldest presently existing in London is the St James' Chronicle. The Times newspaper claims the high character of being the leading journal in Europe. The average number of newspapers annually printed in England at the close of the reign of George II. was 9,464,790; but within the last thirty years they have increased so much in the British dominions, that there is scarcely a county town in which there is not one or more published. They have been adopted as means of communicating intelligence, not only in all our colonies, but throughout Europe and America. Newspapers were first made subjects of taxation, and for this purpose stamped, in the year 1713.

NEWTON, John, an eminent English author and divine, was born in 1725. At an early period of life he was sent to a boarding school in Essex, whence he was removed by his father, who took him to sea at the early age of eleven. Lord Shaftesbury's *Characteristics* having accidentally fallen into the hands of young Newton at Middleburgh in Holland, the perusal of that work had a powerful influence in perverting his morals, and he confesses that from that time he lived like an infidel and a libertine. A series of remarkable events, however, produced a complete change on his mind and manners, not less wonderful than that of Colonel Gardiner's conversion; and having chiefly by his own exertions prepared himself for the ministry, he was ordained by Dr Green, bishop of Lincoln, in 1764, and entered at the same time on the curacy of Olney. Thence in 1779 he was removed to the rectory of the united parishes of St Mary Woolnoth and St Mary Wolchurch Hair, Lombard street, London. He married Mary, the daughter of George Catlet of Chatham, Kent, in 1750, and his almost romantic attachment to this lady, who died in 1790, has been disclosed by the publication of his letters to her both before and after marriage. Mr Newton was fond of music, and likewise occasionally amused himself by making compositions in poetry. But what he chiefly excelled in was letter-writing. The volumes entitled Omicron's Letters, and Cardiphonia, are excellent examples of this species of composition, while they rank high also as an almost complete system of practical Christianity. His sermons on the Messiah are simple and pious. An interesting account of his life, prior to his receiving orders in the church, was drawn up by himself in a series of letter to Dr Haweis, who afterwards published it with a continuation to the time of his death, which took place in 1807.

NEWTON, Sir Isaac, the most eminent mathematician and natural philosopher that has ever appeared, and who for the number and greatness of his discoveries stands altogether unrivalled, was born, 1642, at Woolthorpe in Lincolnshire. According to some, he was descended from the elder branch of the family of Sir John Newton, Bart.; but according to others, and probably with more truth, he was the only child of John Newton of Colesworth near Grantham. His mother, Hannah Ayscough, belonged to the ancient family of the Ayscoughs or Askews of the same county. When Isaac was born, which was about three months after the death of his father, he was so weak and so diminutive in size, that he was not expected to live. At the age of twelve years he was sent to the grammar school of Grantham, under Mr Stolkes, where he gave striking indications of natural genius. His predilection for mechanical contrivances was very extraordinary. Being furnished with a proper set of tools, he was wont to occupy himself in forming models of wood, while his companions were at play. He constructed a wooden clock, and a good imitation of a wind-mill which about that time was erected near Grantham. He introduced the use of paper kites among his school-fellows, and sometimes made tables and cup-boards for the young ladies. At the same time his attention was directed to the apparent motions of the sun, and by means of pegs fixed in the wall of the apothecary's house where he lodged, with proper marks for the hours and half-hours, he was able to point out pretty exactly the time of the day. This contrivance was denominated Isaac's dial. He framed also a *clepsydra*, or water-clock, the index of which was turned by a piece of wood which rose or fell by the dropping of water. These occupations frequently withdrew his attention from his regular studies; but when roused to a little extraordinary exertion, he uniformly proved himself able even to outstrip his school-fellows.

On the death of her second husband, Mrs Newton returned to Woolthorpe, and recalled Isaac from school to be instructed in the management of the farm. It soon appeared, however, that the pursuits of agriculture were not congenial to his mind. When he went to market at Grantham, instead of attending to the sale of the produce, he frequently left it to the servant who accompanied him, and retired to his studies in the house where he had formerly lodged. At home he was usually found poring over his books when he should have been been superintending his labourers. His uncle, at length, having found him one market-day in a hay-loft occupied with a mathematical problem, determined to prevail on Mrs Newton to allow her son to follow his own inclination; and he was accordingly soon after sent to Trinity college, Cambridge, where he was admitted (1660) in the 18th year of his age. Here he attracted the notice of his teachers by the surprising progress he made in his studies, and formed an intimacy with Mr (afterwards Dr) Barrow, which lasted through life. "In learning mathematics," says M. de Fontenelle, "he did not study Euclid, who seemed to him too plain and simple, and unworthy of taking up his time. He understood him almost before he read him, and a cast of his eye upon the contents of his theorems was sufficient to make him master of them. He advanced at once to the geometry of Des Cartes, Kepler's Optics, &c. It is certain that he had made his great discoveries in geometry, and laid the foundation of his two famous works, the Principia and the Optics, by the time he was 24 years of age."

The seductions of analysis seem to have attracted the powerful mind of Mr Newton when at college, and he afterwards regretted having "applied himself to the works of Des Cartes, and other algebraical writers, before he had considered the elements of Euclid with the attention which they deserved." In 1664 he took his degree of bachelor of arts, but in the following year the appearance of the plague at Cambridge interrupted his studies, and obliged him to retire to the country, where he remained for two years. It was in this peaceful seclusion that he received the first glimpse of those grand discoveries which have exalted his name as a philosopher.

While sitting alone one day in a garden, the accidental fall of an apple called his attention to the subject of gravity; and he began to consider that, as this property of matter seemed to experience no diminution at the tops of the highest buildings or the loftiest mountains, it might therefore extend far beyond the earth and its atmosphere, and even to the orbit of the moon. If the moon should be viewed as a falling body constantly deflected to the earth from the rectilineal motion in which it was originally projected, it might be easy, he thought, to calculate the force of gravity at the distance of the moon, and thus to determine whether it was the same thing with that which displayed itself in falling bodies at the surface of the earth. Proceeding, however, on the erroneous idea then common among geographers, that sixty miles make one degree of the meridian, the result of his calculation did not correspond with his theory, and he for that time laid aside any farther thoughts on the subject.

From some of his account of expenses, it appears that, in 1664, Mr Newton had provided himself with a prism. After making this purchase, he from time to time turned his attention to the study of optics. Finding that many eminent mathematical professors were engaged in devising improvements on the telescope, he commenced that useful study by grinding lenses in the form of some of the conic sections.—The result of his researches, however, not answering his expectations, he was led to inquire into the nature of light itself, and with this view he repeated with his prism some of the experiments of Grimaldi. What most struck him with surprise and arrested his attention was, that the spectrum of brilliant colours assumed an oblong form, while, by the received laws of refraction, the image of the sun ought to have been exactly circular. He in this manner discovered, that light, instead of being a homogeneous body, consists of a heterogeneous mixture of differently refrangible rays, and thus founded his New Theory of Light and Colours, supported by appropriate experiments. In the application of this theory to refracting telescopes, he computed the amount of the error which arises from the different refrangibility of the rays, and found it to exceed some hundreds of times that which was occasioned by the spherical form of the lenses. He thence concluded, that could a substance be found capable of being as highly polished as glass, and of reflecting as much light as glass transmits, by giving this an exact parabolic figure, a telescope might be formed free of the errors produced by the compound nature of light.

In 1666 he was elected a fellow of Trinity college, having the year before taken his degree of master of Arts. In the following year, Dr Barrow, who was then Lucasian professor of Mathematics, resigned his chair in favour of Mr Newton, that he might be enabled to devote himself entirely to theology. As he was now desirous to complete his optical enquiries, our philosopher made them the subjects of his lectures for the first three years after his appointment. In 1672 he was elected a fellow of the Royal society, and a telescope, sent by him from Cambridge being on that occasion presented to the society, it was agreed that a description of it should be transmitted by the secretary to Mr Huygens at Paris, for the purpose of securing to Mr Newton the honour of the invention. It was in the Philosophical Transactions for 1671 that his first discoveries, relative to the combination of colours in light, appeared. Several other papers on the same subject were afterwards sent to the society, which occasioned a slight controversy between him and Mr Hook, who claimed the merit of having led the way in his Micrography, but was answered by Newton with a full and clear statement of the difference in their views. On the continent the new doctrines were assailed by Father Pardies and some other Cartesians; but Newton replied to his opponents, and silenced them all in succession.

Resuming his former speculations on gravity in the years 1676 and 1677, he found, by comparing the periods of the several planets with their distances from the sun, that if a power, such as gravitation, hold them in their courses, its strength must decrease in the duplicate proportion of the increase of distance. Picard having, in 1679, measured a degree of the earth with considerable accuracy, Newton now proceeded on better data than in his former attempts, and ascertained that the moon was actually kept in her orbit by the power of gravity. He shewed Dr Halley, when he was at Cambridge in 1684, a treatise on the motion of bodies, which he promised to send to the Royal society to be entered on their register. Having accordingly employed himself, during the remainder of that year, and the whole of 1685, in arranging his discoveries respecting the law of gravity and the planetary motions, he fulfilled his engagement by presenting to the society the manuscript of his well known work, the *Principia,* or Mathematical Principles of Natural Philosophy, in which he gives "a demonstration of the Copernican hypothesis as proposed by Kepler, and makes out all the phænomena of the celestial motions by only the supposition of a gravitation towards the centre of the sun, decreasing as the square of the distance therefrom reciprocally." This great work was ordered by the society to be printed, and a letter was written to solicit the author's consent. The *Principia,* therefore, appeared about the middle of the year 1687,—and although the popularity of the Cartesian philosophy retarded its reception for a time, it at length triumphed over all opposition.

In 1688, Newton was chosen one of the representatives of the university in the convention parliament, which he regularly attended till its dissolution. Eight years after he was appointed warden of the mint, through the interest of Mr Montague (afterwards Earl of Halifax) who was then chancellor of the Exchequer; and in this office he was of signal service when the recoinage took place. The lucrative office of master and worker of the mint was next conferred upon him, which office he held till his death. In 1699 he was elected one of the members of the Royal academy of Sciences at Paris; and in 1703 he received the appointment of president of the Royal society, which situation he held for twenty-nine years. The honour of knighthood was bestowed upon him by Queen Anne in 1705. Upon the accession of George I. Sir Isaac was particularly noticed at court. Caroline, Princess of Wales, afterwards consort to George II. often conversed with him for hours together, and was heard to say, that she deemed it one of the greatest felicities in her life to have lived in the age when she could enjoy the society of such an illustrious man. Sir Isaac having written a treatise of Ancient Chronology for his own use, and without the intention of publishing it, she desired an abstract of it, which she requested him to give, under a promise of secrecy, to Signior Conti, a Venetian nobleman who was then in England. This person proved himself unworthy of the confidence reposed in him, by carrying the copy to Paris, where he caused it to be translated and printed with some observations designed to refute the original work. When this nefarious transaction became known to Sir Isaac, it drew from him some severe but just animadversions, which appeared in the Philosophical Transactions for 1725. The Chronology itself was published in quarto, about two years after his death.

This great man enjoyed excellent health to the age of eighty, when he began to be affected with the stone. Under the severest paroxysms of this disorder, even when large drops of sweat ran down his face, he was never heard to complain, or express the smallest degree of impatience. Before this disorder afflicted him, he was wont to read and write several hours every day. The fatigue of attending a meeting of the Royal society, occasioned a severe attack of his disease in 1727. About fifteen days after this he seemed to be considerably relieved, and the hopes of his friends were revived; but on the 18th of March, after a long conversation with Dr Mead, in which he had evinced the usual vigour of his faculties, he became insensible about six o'clock in the evening. In this state he continued during the whole of the following day, and on Monday the 20th he died between one and two o'clock in the morning, having reached the advanced age of eighty-four years and a few months.

The corpse of this great philosopher lay in state in the Jerusalem Chamber, adjoining the House of Lords, till the 28th of March, when it was conveyed to Westminster abbey, and interred just at the entrance into the choir, where a splendid monument was erected to his memory. The magnificent honours paid to the remains of Sir Isaac Newton were highly creditable to the nation. By the munificence of Dr Smith, master of Trinity college, Cambridge, an admirable full length statue of him was placed in the outer chapel of that college, but it has since been removed to the Senate-house. The only portrait for which he sat was by Kneller, and this portrait is said to be now in the possession of the Duke of Rutland.

Sir Isaac was of middle stature, and in the latter part of his life rather inclined to be stout. His countenance was pleasing and venerable, retaining, almost to the close of his life, the ruddy glow of health, though it is said to have indicated little of that penetrating sagacity which characterizes his compositions. He made no use of spectacles, and during his long life he had lost only one tooth. In the character of this great man, modesty formed a striking feature. Possessing much serenity of mind, and being an ardent lover of peace, and wholly unacquainted with those petty jealousies which prompt some men to dispute the claims of others, he disliked nothing so much as the controversies in which he was sometimes compelled to engage, though, when necessary, he never hesitated to answer his antagonists with firmness and spirit. He always put himself upon a level with his company, and was never heard to boast of his discoveries. In his habits he was extremely regular and temperate. That he was a sincere Christian has never been doubted but by those who wished him to have been an infidel. Though sincerely attached to the Church of England, he was the avowed friend of toleration. His regard for every thing sacred was evinced, not only by the whole tenor of his life, but by a volume of Observations on the Prophecies of Daniel and the Apocalypse of John. After all that he had demonstrated of the laws of nature, and without renouncing any one principle he had established, he had stated, in a correspondence with Dr Bentley, that "though gravity might give the planets a motion of descent towards the sun, yet the transverse motions by which they revolve in their several orbs require the divine arm to impress them according to the tangents of their orbs;"—so far was he from feeling in his system any sanction to the atheistical fidelity which too many have supposed essential to sound philosophizing.

His personal estate, to the amount of L.32,000, was divided among five nephews and nieces, and the land which he inherited descended to John Newton, whose great-grandfather was Sir Isaac's uncle. Besides the works published by him in his lifetime, a vast number of disquisitions and treatises were found among his papers after his death, on subjects of antiquity, history, divinity, chemistry, and mathematics, many of which were published at different times, as appears from the following statement:

1. Several Papers relating to his Telescope, and his Theory of Light and Colours, printed in the Philosophical Transactions, Vols. 6, 7, 8, 9, 10, 11.

2. Optics, or a Treatise of the Reflections, Refractions, and Inflections, and the Colours of Light, 1704, 4to.

3. Optical Lectures, 1728, 8vo.; also in several Letters to Mr Oldenburg, Secretary to the Royal Society.

4. Lectiones Opticæ, 1729, 4to.

5. Naturalis Philosophiæ Principia Mathematica, 1687, 4to.

6. A System of the World, translated from the Latin original, 1727, 8vo. This was at first intended to make the third book of his Principia. An English Translation by Motte, 1729, 8vo.

7. Several Letters to Mr Flamsteed, Dr Halley, and Mr Oldenburg.

8. A Paper concerning the Longitude, drawn up by order of the House of Commons.

9. Abregé de Chronologie, &c. 1726, under the direction of the Abbé Conti, together with some Observations upon it.

10. Remarks upon the Observations made upon a Chronological Index of Sir I. Newton, &c. Philosophical Transactions, Vol. 33. See also the same, Vols. 34 and 35, by Dr Halley.

11. The Chronology of Ancient Kingdoms Amended, &c. 1728, 4to.

12. Arithmetica Universalis, &c. under the inspection of Mr Whiston, Cantab. 1707, 8vo. Printed without the author's consent, and even against his will,—an offence which, it seems, was never forgiven.

13. Analysis per Quantitatum Seriæs, Fluxiones, et Differentias, cum Enumeratione Linearum Tertii Ordinis, 1711, 4to. under the inspection of W. Jones, Esq. F. R. S.

14. Several Letters relating to his dispute with Leibnitz, upon his right to the invention of Fluxions; printed in the Commercium Epistolicum D. Johannis Collins et Aliorum, de Analysi Promota, jussu Societatis Regiæ editum, 1712, 8vo.

15. The Method of Fluxions and Analysis by Infinite Series, translated into English from the original Latin; to which is added, a Perpetual Commentary by the translator, Mr John Colson, 1736, 4to.

16. Several Miscellaneous Pieces and Letters, as follows: 1. A Letter to Mr Boyle upon the Subject of the Philosopher's Stone; inserted in the General Dictionary under the article *Boyle*. 2. A Letter to Mr Aston, containing Directions for his Travels; ibid. under our author's article. 3. Observations on the Prophecies of Daniel, and the Apocalypse of St John, 1733, 4to. 4. Tables for purchasing College Leases, 1742, 12mo. 5. Corollaries, by Whiston. 6. A Collection of several Pieces of our author's, under the following title: Newtoni, Is. Opuscula Mathematica Philos. et Philol. Collegit I. Castilioneus, Laus. 1744, 4to. 8 tomes. 7. Two Treatises of the Quadrature of Curves, and Analysis by Equations of an Infinite Number of Terms explained, translated by John Stewart, with a large Commentary, 1745, 4to. 8. Description of an Instrument for observing the Moon's Distance from the Fixed Stars at Sea. Philosophical Transactions, Vol. 42.

An edition of the whole works of Sir Isaac Newton was published by Dr Horsley, in five volumes 4to, in 1779. See Fontenelle's *Eloge des Academiciens*, Tom. II. 293-323.; *Biblioth. Angloise*, Tom. XV. Par. ii. 545.; and Mr Maclaurin's *Account of the Discoveries of Sir Isaac Newton*. A complete list of Newton's works and papers is contained in Hutton's *Mathematical Dictionary*.

NEWTON, Thomas, bishop of Bristol, an eminent divine of the church of England, was born at Litchfield in 1704. He received the elements of learning first at Litchfield, and afterwards at Westminster school, and then entered at Trinity college, Cambridge, where he afterwards resided eight months every year, till he took his degree of batchelor of arts, and was elected fellow of his college. Having received ordination from Bishop Gibson in 1730, he was for some years curate of St George's, Hanover Square, London, and assistant preacher to Dr Trebeck, whose daughter he married. In 1744, he was presented to the rectory of St Mary-le-Bone; in 1745, he took his doctor's degree, and two years after he published his edition of Paradise Lost. This was followed by an edition of Paradise Regained; and he is said to have derived more profits from these editions than Milton himself did by all his works put together. But his chief advantage, he says, was their being the means of introducing him to the friendship of Drs Warburton and Jortin. In 1754, he lost both his father and his wife, trials which almost overwhelmed him. He was then engaged in writing his Dissertations on the Prophecies; the publication of which in two volumes, at an interval of three years, procured him preferment to the deanery of Salisbury, and the situation of sub-almoner to his Majesty. In 1764, when Dr Stone, the primate of Ireland died, Mr Grenville requested Bishop Newton to accept of the primacy, but this he declined. Four years afterwards he was made dean of St Paul's, and consecrated bishop of Bristol. From that period he laboured almost constantly under ill health; and he died in 1782, at the age of 78.

Of his numerous works, the Dissertations on the

Prophecies are the most valuable. They were occasioned by a conversation with the celebrated Marshal Wade. That general having alleged, as many infidels gratuitously do, that the prophecies so called were written after the events, our author affirmed that prophecies there are of such undeniable antiquity, that they must have existed prior to the events,—others clearly fulfilled, or yet to be fulfilled, since the commencement of the Christian era, which were previously in the hands of the Jews, and known to the heathen. Startled at this assertion, Marshal Wade acknowledged that, could these facts be established, the evidence of revelation would be altogether irresistible. How ably Bishop Newton has made out the facts, has long been admitted. The style of his writings is heavy and inelegant, but correct and sufficiently perspicuous; the mass of information is great; and no one will question for a moment the learning and candour of the author.

NEWTONIAN PHILOSOPHY, the philosophy so called from its author Sir Isaac Newton, and contained in his *Principia*; a work which, as one of his biographer's observes, "may be looked upon as the production of a celestial intelligence rather than that of a man."

In their application of the term Newtonian philosophy, authors differ materially. According to some, the Newtonian is the same with the system of natural philosophy, in opposition to the Cartesian, the Peripatetic, and the ancient Corpuscular philosophy. According to others, it signifies that part of physical knowledge which is improved and demonstrated in the *Principia*. Others understand the Newtonian as being the same with experimental philosophy, and apply it to the order or method of philosophizing observed by Sir Isaac, that is, the reasoning and drawing of conclusions directly from phenomena, exclusive of all previous hypothesis, beginning from simple principles, deducing the laws of nature from a few select phenomena, and then applying them to account for others. The term likewise is understood to signify that philosophy wherein physical bodies are considered mathematically, and where geometry and mechanics are employed for the solution of phenomena; and according to this view it has obtained the name of mathematical and mechanical philosophy. Lastly, the term has been more accurately defined, the new principles introduced into natural philosophy by Sir Isaac, the system established thereon, and the new solutions of phenomena thence deduced; which characterises the philosophy of Newton from all others.

The doctrine of the structure of the universe, and especially of the heavenly bodies, their laws, affections, &c. as delivered in the *Principia*, has for its basis the great principle of the power of gravity,—a principle long since hinted at by Kepler, whose prediction, "that the discovery of the true laws of gravity were reserved for the succeeding age, when the Author of Nature would be pleased to reveal those mysteries," has been fully verified in the discoveries of the English philosopher. Kepler, indeed, had observed some of the properties of this principle, and its effects on the revolutions of some of the primary planets; but the complete discovery of the influence of this principle in all its bearings was reserved for the illustrious author of the *Principia*. The demonstration of this great power of gravitation from numerous phenomena, together with its application to various other appearances of nature, or the deducing those appearances from that principle, strictly speaking, constitutes the Newtonian philosophy.

This philosophy is illustrated by Sir Isaac chiefly in his third book of the *Principia Mathematica*. Having, in his first and second books, demonstrated such principles of mathematics as are most allied to philosophy, he proceeds in the third, which he calls *De Mundi Systemate*, to deduce the structure of the universe and the powers of gravity by which bodies tend towards the sun and the planets; and from these powers the motions and revolutions of the planets and comets, the theory of the moon and the tides. This new philosophy was originally written in a popular manner, but the author afterwards digested the substance of it mathematically into propositions, that the reader might be induced first to make himself in some degree master of the principles, to enable him to conceive the force of the consequences; and the author directs that, after perusing the definitions, the laws of motion, and the three first sections of the first book, we may proceed to the book *De Systemate Mundi*.

At its first publication, in 1686, the Newtonian philosophy, though well received at home, was slow in gaining ground abroad; but having prevailed over the systems of Des Cartes, Huygens, and Leibnitz, it is now held both at home and abroad in the greatest estimation. In 1723, it was republished by the author with various improvements. Attempts have since been made to simplify it by different philosophers, especially Whiston in his *Prelect. Phys. Math.* 's Gravesande in his *Elem.* and *Inst.* Le Seur and Jacquier in their *Comment upon the Principia*, Dr Pemberton in his *View*, and Maclaurin in his *Account of Sir Isaac Newton's Discoveries.*

The great leading principles of the philosophy of Sir Isaac Newton are necessarily embraced under astronomy, mathematics, mechanics, and other articles in this work; but what principally distinguishes that philosophy from all others, is briefly comprised in the following particulars.

1. The phenomena are,—that Jupiter's satellites, by radii drawn to the centre of the planet, describe areas proportional to the times; and that their periodical times, the fixed stars being at rest, are in a sesquiplicate ratio of their distances from its centre. The same thing holds of the satellites of Saturn with regard to Saturn, and of the moon with regard to the earth. The fixed stars being supposed at rest the periodical times of the five primary planets, and of the earth about the sun, are in sesquiplicate proportion of their mean distances from the sun. The primary planets, by radii drawn to the earth, do not describe areas any way proportional to the periodical times, but the areas which they describe by radii drawn to the sun are proportional to the times of description. The moon, by a radius drawn to the centre of the earth, describes an area proportional to the time of description.

2. The powers by which Jupiter's satellites are

constantly drawn off from rectilinea motions, and retained in their proper orbits, respect the centre of Jupiter, and are reciprocally as the squares of their distances from the same. This likewise holds of the satellites of Saturn with regard to that planet; of the moon with regard to the earth; and of all the primary planets with regard to the sun.

3. By the power of gravity the moon is retained in her orbit, and gravitates towards the earth; and the same thing is likewise observed of the other satellites with regard to their primary planets, and of the latter with regard to the sun. As to all the other secondary planets their phenomena with respect to their primary ones being similar to those of the moon about the earth, it is reasonable to presume that they depend upon the same causes, and consequently the primary planets gravitate towards their secondary ones, the earth towards the moon, and the sun towards them all.

4. All bodies gravitate towards every planet, and the weights of bodies towards the same planet, at equal distances from its centre, proportional to the quantities of matter in each. By many experiments, it has been proved that the descent of all heavy bodies towards the earth, allowance being made for their unequal retardation from the resistance of the air, descend to the earth from equal heights in equal times; and the nature of gravity, no doubt, is the same on the other planets as on the earth. Sir Isaac tried an experiment in silver, gold, lead, sand, glass, common salt, wood, water, and wheat. Two wooden boxes being provided, round and equal, the one he filled with wood, and suspended an equal weight of gold in the centre of oscillation of the other. The boxes being suspended by equal threads of eleven feet, they vibrated like a couple of pendulums, perfectly equal in figure and weight, and receiving equally the resistance of the air. Placing the one by the other, he observed them to play together for a long time with equal vibrations,—and therefore he concluded that the quantity of matter in the gold, to the quantity of matter in the wood, was as the action of the motive force upon all the gold to the action of the same upon all the wood, that is, as the weight of the one to the weight of the other. The same was the case in the other bodies. From this and other experiments, several corollaries are drawn respecting the weights of bodies on the surface of the earth, magnetism, and the existence of a vacuum. Sir Isaac concludes that, in the spaces near the earth, the resistance of falling bodies is occasioned only by the air, exhalations, and vapours, but that these are not to be found in the higher regions, and that, therefore, the celestial regions being perfectly void of air and exhalations, the planets and comets meeting no sensible obstruction in those spaces, continue their motions through them for an immense space of time.

5. The power of gravity extends itself to all bodies proportional to the several quantities of matter which they contain; whence it follows that the force of gravity towards any whole planet arises from, and is compounded of, the forces of gravity towards all its parts,—and of this, electric and magnetic attraction affords an example; for all attraction towards the whole arises from the attractions towards the several parts, and this may be easily comprehended, if we consider a greater planet as formed of a number of lesser planets meeting together in one globe. This is finely illustrated by the numerous experiments which have been made with regard to the attraction of mountains. The power of gravity towards the several equal particles of any body, is reciprocally as the square of the distance of places from the particles; and hence we derive the methods of finding and comparing weights of bodies towards different planets—of finding the quantity of matter in these planets, and their densities; since the weights of equal bodies revolving about planets are as the diameter of these orbits directly, and as the squares of the periodical times inversely; and the weights at any distance from the centre of the planet are greater or less in a duplicate ratio of their distances inversely.

6. The common centre of gravity of the sun, and all the planets, is at rest; and the sun, though always in motion, yet never recedes far from the common centre of all the planets. The common centre of gravity of Jupiter and the sun, will be a point a little without the sun's surface; and the common centre of Saturn and the sun, will be a point a little within the sun's surface, and the common centre of the earth and all the planets will be scarcely one diameter of the sun distant from the centre thereof; but the centre is always at rest,—therefore, though the sun will have a motion this and that way, according to the various situations of the planets, yet it can never recede far from the centre; and hence the common centre of gravity of the earth, sun, and planets, may be esteemed the centre of the world.

7. The planets move in ellipses that have their foci in the centre of the sun, and describe areas proportionable to their times. If the sun were at rest, and the other planets did not act on each other, their orbits would be elliptical, having the sun in the common umbilicus, although the mutual actions of the planets are so very small that they are not deserving of consideration, excepting the action of Jupiter on Saturn, and that of the moon upon the earth's orbit, by which they may be sensibly disturbed.

8. The aphelia and nodes of the planets are at rest, excepting for some small irregularities, occasioned by the action of the revolving planets and comets.

9. The polar diameter of the planets is less than the equatorial. Had they no diurnal rotation, the planets would be spheres, as having an equal gravity on every side; but by this rotation the parts receding from the axis endeavour to swell towards the equator, which, if the matter they consist of be of a soft or fluid nature, will be affected very sensibly. Accordingly, unless our earth were higher at the equator than towards the poles, the sea would rise under the equator, and overflow the land near it. All the inequalities of the moon's motions result from these principles; her unequal velocity, and that of her nodes and apogee in the syzgies and quadratures, the differences in her excentricity and her variation.

10. The several inequalities in the motions of the satellites may be deduced from the inequalities of the lunar motions.

11. From these principles, and particularly the action of the sun and moon upon the earth, it follows

that the sea must swell and subside twice every day, or, in other words, that there must be tides.

12. From these principles also may be deduced the whole theory of comets,—as that they are above the region of the moon, and in the planetary spaces; that they shine by the sun's light, which is reflected from them; that they move in conic sections, whose umbilici are in the centre of the sun; that the orbits are very nearly parabolas; that their bodies are solid and compact, and that they must, therefore, acquire an immense heat in their perihelia; that their tails are exhalations arising from and encompassing them like atmospheres.

NIAGARA, a town and fort of New York in Ontario county, on the east side of the river of the same name, at its entrance into lake Ontario, and opposite Newark in Upper Canada. The fort, which was erected by the French in 1751, is situated 16 miles below the great cataract called the Falls of Niagara.

NIAGARA, a river of the United States, which issues from the north-east end of the lake Erie, forms the boundary between the United States and Upper Canada, and falls into lake Ontario. This river is 36 miles in length, and from half a mile to a league in breadth. Its falls are the most celebrated waterfals in the known world; and the most creditable authors declare that no power of language can give an adequate idea of their sublimity. The Niagara is a part of the St Lawrence, which is probably exceeded by no river, except the Amazon, in its annual tribute to the ocean. It is subject to no floods, is never swollen at one season of the year nor shrunk at another. Lake Erie, on proceeding from which it assumes the name of Niagara, is situated upon the horizontal strata of a region elevated nearly 300 feet above the level of the country which contains lake Ontario. The descent which separates the two countries is, in some places, almost perpendicular; and the immense declivity formed by such strata occasions both the cataract of Niagara and the great falls of Cheneseco. When the river issues from lake Erie it is about 800 yards broad. At the ferry, about two miles from the lake, its width is reckoned a mile; and the average rapidity from thence to fort Chipeway, six miles an hour. The depth is about 25 feet. In proceeding downwards the channel widens, the rocks disappear, and the waters glide smoothly along. Above fort Chipeway there is no appearance of a rapid; below it the channel again becomes rocky, and the gradual rise of the banks indicates a very uncommon descent in the level of the river.

The site of the cataract is 21 miles from lake Erie and 15 from lake Ontario. About two miles from this place the surface is broken by a succession of parallel ledges of rock, which extend in an irregular succession down to the fall, and many of them reach nearly across the river. Above the fall, in the middle of the river, which is there nearly three miles in width, an island called Goat island presents itself, the lower end of which is just at the perpendicular edge of the precipice. By this the waters are divided into two distinct cataracts. The one on the Canadian side is 600 feet broad, and the fall 150 feet; the other on the American side is 350 feet wide, and 164 in perpendicular height. The river forces its way amidst the rocks with redoubled impetuosity as it approaches the falls; at last coming to the brink of the tremendous precipice, the whole body of water tumbles down to the bottom without the smallest interruption in its descent. The front of the river is rendered very spacious by the semicircular form of the ledge of rocks over which it is precipitated. In a clear day and fair wind, the noise of the falls may be heard at the distance of thirty or forty miles. The amazing velocity with which the torrent of water, after making the great pitch, descends to the bottom of the chasm, communicates a tremulous motion to the ground, which may be sensibly felt at a considerable distance. The spray ascends to a great height, and forms beautiful rainbows in the rays of the sun. Immediately below the great pitch, a commixture of foam and water is puffed up in spherical figures, of the size of a common hay-cock. These burst at the top, and discharge a column of spray at a great height; they then subside, and are succeeded by others. This phenomenon is supposed to be occasioned by the ascent of the air which has been carried down by the column of water towards the bed of the river. Many wild beasts, in attempting to cross above the cataract, are borne away to it by the rapids; even geese or ducks, if they inadvertently alight in these rapids, are incapable of rising on the wing again. The bottom of the chasm cannot be reached without considerable difficulty by those who wish to examine minutely this magnificent scene; but when there they can approach pretty near the cataract with safety; and the noise is said not to be so astounding as when heard from the top grounds or from a greater distance. The waters, however, form no arch under which visitors might pass, as some have alleged. The descent is almost, if not entirely, perpendicular. The most creditable and satisfactory account of the falls of Niagara are given by Mr Ellicot in the American *Philosophical Transactions*, Mr Morse in his *American Geography*, and Mr Duncan in his *Travels*.

NICE, the capital of a province of the same name in the Sardinian states, which is bounded on the east by the duchy of Genoa, on the west by the river Var and the Maritime Alps, on the south by the Mediterranean, and on the north by Piedmont. This ancient city is said to have been founded by the Phocæans about five hundred years before Christ. It is pleasantly situated near the mouth of the river Paglione. Though the streets of the old town are narrow, and rendered dark and gloomy by the height of the houses, those of the new town are spacious. The harbour of Nice is protected by a mole, and is capable of admitting vessels of 300 tons. The adjacent country is delightful, the plains being adorned with vines, pomegranates, oranges, lemons, &c., and the hills shaded to the top with olive plantations, in the midst of which appear villas and country-houses. Winter here is said to be as warm as the month of May in England. The beautiful scenery and fine climate of this place render it the resort of invalids, especially those of consumptive habits. The population is estimated at 18,500. Nice exports dried fruits of all kinds, rice, cordials, wine, silk, and sweet oil.

**NICENE CREED**, a summary of the Christian faith, drawn up in opposition to the doctrines of Arius, by the famous council which Constantine the Great assembled at Nice in Bithynia, anno 325. This creed asserts the consubstantiality of the Son with the Father; but the terms on which it does so are not altogether unexceptionable. It was, in 381, confirmed, with some alterations, by the council of Constantinople; from which circumstance it is sometimes called the Constantinopolitan creed.

**NICEPHORUS, Calistus**, a learned monk of Constantinople, who flourished in the fourteenth century. He compiled an ecclesiastical history in twenty-three books, eighteen of which are still extant, bringing down the history of the church to the death of the emperor Phocas in 610. Though debased with idle stories, and evident marks of superstition, this work is useful on account of the light which it throws on many important facts in ecclesiastical history.

**NICEPHORUS, Gregorias**, a Greek historian of the fourteenth century, librarian of the church of Constantinople, and a great favourite of the emperor Andronicus, who once commissioned him to act as his ambassador to the prince of Servia. Under the younger Andronicus, he employed his influence successfully to prevent the Greek church from entering into any conference with the legates of Pope John XXII. His chief work is the Byzantine History, in eleven books, comprehending all that passed from the year 1204, when Constantinople was taken by the French, to the death of Andronicus III. in 1341. Of this work the best edition is that of the Louvre, in Greek and Latin, 1702.

**NICERON, John Francis**, a distinguished mathematician, was born at Paris in 1613. Having completed his academical studies, he, in his 19th year, entered into the order of Minims. He early discovered a strong predilection for mathematics, to the study of which he ardently applied himself when his time was not necessarily occupied with the duties of his profession. In the science of optics he made astonishing progress; and some performances, displaying his admirable skill in this branch of mathematics, were left behind him in different houses belonging to his order, especially that at Paris. After he had visited Rome twice, and had been appointed teacher of theology, he was nominated to accompany F. de la Noue, vicar-general of the order, in his visitation of all the convents in France. About the year 1644, Niceron had the happiness of being introduced to Des Cartes, who shewed him great kindness, and complimented him with his "Principles of Philosophy." The republic of letters experienced a severe loss by the death of this young monk at Aix in Provence, in 1646. His works are *Thaumaturgus Opticus, L'Interpretation des Chiffres*, and *La Perspectif Curieuse.*

**NICERON, John Peter**, author of *Memoirs of Men illustrious in the Republic of Letters*, was descended of an ancient and noble family, and born at Paris in 1685. After he had prosecuted his studies in the Mazarine college at Paris, and at the college Du Plesiss, he became a probationer to the society of Barnabite Jesuits, was received into that body in 1702, and he took his vows in 1704 at the age of 19. He was then sent to Montarges to study philosophy and theology, and afterwards to Loches in Louvaine to teach those sciences. Niceron was ere long recalled to the college of Montarges, and appointed professor of rhetoric and of philosophy. Both the ancient and modern languages were understood by him. He died in 1738. Between the years 1727 and 1738, the *Memoirs of Men illustrious in the Republic of Letters*, with a critical account of their works, was published in 12mo, at Paris, as far as the 39th volume, and the 40th volume appeared in 1739.

**NICHOLLS, Frank**, an eminent physician and anatomist, was born in London in 1699, and educated at Westminster school, after which he was admitted a commoner of Exeter college, Oxford. Having a strong predilection for the medical profession, he entered on the study of anatomy, which he prosecuted with much ardour and success. At Oxford he took his degrees, and became reader of anatomy. After visiting the principal anatomical and medical schools on the continent, he settled in London, and soon brought himself into notice as a lecturer on anatomy and the practice of physic. In the year 1728 he was chosen a fellow of the Royal Society, the *Transactions* of which he enriched with a variety of communications. At the age of forty-five he married Elizabeth, the youngest daughter of the celebrated Dr Mead, by whom he had five children. On the death of Sir Hans Sloane, Dr Nicholls was chosen to succeed him as one of the king's physicians. The latter years of his life were spent in agreeable retirement at Epsom. He died of asthma, in 1779, in the eightieth year of his age. Dr Nicholls was the author of the well known satirical pamphlet, entitled, "The Petition of the Unborn Babes to the Censors of the Royal College of Physicians of London."

**NICHOLS, William**, an eminent English divine, born at Donnington in Bucks, in 1664, and died in 1712. As an author he is known chiefly by his *Conference with a Theist*; a work which it is supposed suggested to Hervey the plan of his Theron and Aspasio. He devoted himself entirely to piety and study; and, in defence of Christianity and the Church of England, he published no fewer than nineteen works in Latin and English. Among the valuable manuscripts preserved at Lambeth, there is a volume of letters in Latin, between this learned divine and Joblonski, Ostervald, Wetstein, and others, which was presented by his widow in 1712 to the archbishop of Canterbury.

**NICOBAR ISLANDS**, a group of islands situated at the entrance of the gulph of Bengal, between the 6th and 10th degrees of north latitude, and the 93d and 95th of east longitude. They are nineteen in number, of which seven are of considerable size. The largest is Sambelong, towards the south. Carnicobar, the most northerly, and Nancoury, in the centre, are most visited by Europeans. Some of these islands are very small, but the largest, called Great Nicobar, is about five leagues in circumference. Being in general hilly, and covered with wood, they abound in rich scenery. The atmosphere, tempered by the sea-breezes, is seldom sultry, yet the climate is regarded as very unhealthy to Europeans. The soil, hough almost entirely uncultivated, produces, in great perfection, most of the fruits and vegetables of tropical countries. The forests abound with fine timber, of large growth; and such is the luxuriance of vegetation, that the interior of the woods is rendered impenetrable even to the natives, and the light of day is wholly excluded by the foliage of the trees. Plantains, limes, tamarinds, cinnamon, sassafras, the coffee-tree, and the larum, or mellory, a species of bread-fruit, are common. The mango, and likewise pine-apples of the finest flavour, grow wild in the woods. The principal animals are dogs and swine. Buffaloes, supposed to have been introduced by the Danes, roam at large in the forests. Monkeys are numerous in the most southern islands. Bats of large size and hideous aspect are not uncommon. Crocodiles, venomous serpents, and a deadly species of scorpion, infest these islands. Of the feathered tribes, the most prevalent are pheasants, turtle-doves, parrots, pigeons, and swallows. The swallows are black like the martin, but smaller. Their nests, which are built in the cavities of the rocks, consist of a gelatinous substance, and have been long esteemed a delicious article of food by the Chinese.

The Nicobar islands are but thinly peopled. The natives are brown or copper-coloured, with a physiognomy which seems to combine the features of the Tartar and the Negro. They are low in stature, and well proportioned in their bodies, but very indolent. For the most part the only covering of the men is a narrow piece of cloth wrapped round the waist, and passed through between the thighs, with one extremity hanging behind,—a circumstance which led Kioping, a Swedish navigator, and some others, probably on his authority, to allege that they were a people having tails. They live in huts which are elevated on bamboos, about five or six feet from the ground. Their chief occupations are building and repairing their huts, fishing, and sometimes trading to the other islands, or cultivating a little patch of ground. They are remarkable for hospitality, and theft is of rare occurrence among them. In travelling to a distance a Carnicobarian will pass through many villages on his way without regarding any person; and when occasion calls will enter a house, make use of any food he can find without asking permission, and rest himself for a time without taking the least notice of any of the family, unless he has something important to communicate. The notions respecting a deity entertained by these islanders are very indistinct. As they worship the devil from fear, a long pole is observable in every village having strings of ground rattans dangling from it, which are superstitiously imagined to have the power to keep him at a distance. At the death of a native, not only his hatchet and lances and household utensils, but sometimes even his live-stock are interred with him.

Scarcely any thing worthy of the name of government appears to exist in the Nicobar islands. A few persons, from their age, seem to have peculiar respect paid to them; and there is a principal individual in each village, whose power, however, reaches no farther than friendly remonstrance. The main bond of society among these islanders seems to be mutual good offices. The language spoken by them is derived from the Malay, and resembles the dialect of Pegu.

NICOLAITANS, a heretical sect in the primitive age of Christianity, who are generally supposed to have derived their origin and name from Nicholas of Antioch, one of the first deacons of the church of Jerusalem. This sect allowed a community of wives, and made no distinction between ordinary meats and those offered to idols. Not only the *deeds* but the *doctrine* of the Nicolaitans are stigmatised in Scripture. Rev. ii. 6. Eusebius affirms that they did not subsist for any length of time; but Tertullian says that they merely changed their name, and that their heresies passed into the sect of the Cainites.

NICOMEDIA, in ancient geography, the capital of Bithynia, in Asia. It derived its name from Nicomedes I. who enlarged and embellished it. From ancient history, it appears to have been a place of great importance, not only under its own kings, but likewise under the Romans. Nicomedia was the royal residence of Dioclesian, and of Constantine the Great while the city of Constantinople was building. It now bears the name of Ischmitch, or Schmit. See SCHMIT.

NICOTIANA, TOBACCO, a genus of plants belonging to the Pentandria class. There are seven species, the most remarkable of which is *N. Tabacum,* common tobacco. Two varieties of this species are distinguished by the names *Oronooko* and *sweet-scented tobacco.* Sir Walter Raleigh is said, on his return from America, to have first introduced the smoking of tobacco into England. It is not a little singular that the name tobacco has prevailed over the original one *petum,* in all the languages of Europe, with very little variation, and even in Tartary and Japan. *Petum* is the Brazilian name; tobacco is derived from the island of Tobago.

NIECE, a brother or sister's daughter, which, in civil law, is reckoned the third degree of consanguinity, and in common law the second.

NIEPER. See DNIEPER.

NIEVRE, one of the central departments of France, derives its name from the Nievre, a small stream originating in Champlemy, and falling into the Loire at Nevers. It contains an area of 2800 square miles, and a population of 251,000. Nievre produces hemp, in great quantities, corn, wine, iron coal, and mineral waters. The forests occupy about 400,000 acres. Nevers is the capital.

NIEUWENTYT, BERNARD, an eminent Dutch philosopher and mathematician, who flourished in the 17th and early part of the 18th century, and was a native of Westgraafdyk, in North Holland. From his early years he evinced no ordinary talents, and his father, who was a clergyman, was therefore induced to bestow upon him a very liberal education. Young Nieuwentyt possessed an insatiable thirst for learning, and the first science to which he particularly directed his attention was logic. In this science he grounded himself upon the principles of Des Cartes, whose philosophy pleased him exceedingly. He next made himself familiarly acquainted with the various departments of the mathematics, and then commenced the study of medicine, while, at same time he entered upon a course of reading on jurisprudence. Amidst the various subjects of enquiry which occupied his capacious mind, he failed not to pay a due attention to the great and fundamental principles of natural and revealed religion. So amiable and engaging was his character, that when he became councillor and burgomaster of the town of Parmerend, he acquired great credit and influence, and might easily have acquired some of the higher offices of government; but he aspired after no other posts besides what he possessed. This excellent man died in 1718, aged 63 years. His works are, a Refutation of Spinoza; Considerations on the Analysis of Quantities Infinitely Small; Analysis of Curves, by the Doctrine of Infinites; Considerations on the Principles of the Differential Calculus; The Existence of God demonstrated by the Works of Nature; Contemplations on the Universe,—which latter has been translated into English under the title of the English Philospher, in 3 vols. 8vo.

NIGER, a great river of Central Africa, supposed to originate in the mountains of Kong, in the west part of Nigritia. See AFRICA, and *Hydrography* under GEOLOGY.

NIGHT is that period in which the sun is below the horizon. It is long or short according to the position of the place and the season of the year. By the ancient Gauls and Germans, time was divided not by days, but by nights, a method which is still followed by the people of Iceland and the Arabs. Our Saxon ancestors are likewise said to have done the same. See *Chronology* under HISTORY.

NILE, a celebrated river of Africa, which traverses Egypt through its whole extent, and, by its inundations, promotes the fertility for which that country is remarkable. See EGYPT.

NILOMETER, or NILOSCOPE, anciently called Mikeas, or rather Mykeas, from the Greek, signifying *to roar*, or *make a hollow sound*, is a column set up in a well having a communication with the Nile, for the purpose of ascertaining the height of that river in its periodical overflowings. Several Arabian writers assert that the Nilometer was first set up by Joseph during his regency in Egypt; the measure of it was sixteen cubits, this being the height of the increase of the Nile which was necessary to promote the fertility of the country. Some account of the Nilometer has already been given under CAIRO, and also in Chap. I. of GEOLOGY.

NIMEGUEN, an ancient and fortified town of the Netherlands, capital of Gelderland, situated on the Waal, across which there is a flying bridge. It contains a magnificent town-house, an old palace, and a number of handsome churches. The inhabitants, amounting to about 13,000, subsist chiefly by brewing and their trade with Germany.

NIMIQUAS, two tribes of people in the south of Africa, called by Vaillant the Greater and Less Nimiquas. Of these, the former, who are handsome and of good stature, inhabit a sterile country, stretching from the mountains of Camis to the sea on the west; that is, from 15° 25′ to 18° 25′ east longitude of London, and between 25° and 28° south latitude. The latter occupy a country nearly in the same longitude, but lying between 28° 12′ and 29° 36′ south latitude.

NIMROD, the sixth son of Cush, particularly, though briefly noticed, by the sacred historian Moses. To find this remarkable character in profane history, authors have been at much pains. By some, he has been supposed to be the same with Belus, the founder of the Babylonish empire; and by others, with Ninus, the first monarch of Assyria. Some imagine he was Evechous, the first Chaldean king, and others conceive a resemblance between him and Bacchus. It is maintained by some of the Jews that he is the same with Amraphel, the king of Shinar, mentioned by Moses; and some of the Rabbins say he was slain by Esau, whom they absurdly make his cotemporary.

NINEVEH, in ancient geography, the capital of the empire of Assyria, was situated, it is said, on the banks of the Tigris, and was one of the most famous and extensive cities of the world. So great was its circuit, that the prophet Jonas was three days in passing through this city. The exact time of the foundation of Nineveh cannot well be ascertained, but it was probably founded not long after the building of Babel. According to Diodorus Siculus, it was 480 stadia, or 47 miles in circumference, and was surrounded with lofty walls and towers, the former being 200 feet in height, and so broad that three chariots might be driven on them abreast; and, according to Strabo, it was considerably larger than Babylon. This celebrated city was subdued by Arbaces and Belesis, A.M. 3257, under the reign of Sardanapalus, in the time of Ahaz king of Judah. It was a second time taken by Astyages and Nabopolassar, from Chynaladanus king of Assyria, A.M. 3378. Its ancient splendour rapidly declined after this period; and in the time of Lucianus Samosatensis, who lived under the emperor Adrian, Nineveh was so completely ruined that no traces of it could be discovered. After being rebuilt by the Persians, it was again demolished by the Saracens. The ruins of it, modern travellers affirm, may still be seen on the eastern banks of the Tigris.

NIO, an island of the Archipelago, anciently called Ino, Ios, and Dios, situated to the south of Naxia in west longitude 25° 35′ and north latitude 36° 43′ is about 53 miles in circumference, and is fertile in corn. In the manners of the inhabitants, who are Greeks, is revived some idea of the simplicity of the primitive ages.

NIOBE, in mythology, the daughter of Tantalus, and wife of Amphion, king of Thebes, to whom she had seven sons and seven daughters. Having become elated, on account of her being the mother of so many sons and daughters, she had the presumption to prefer herself to Latona, and she refused those sacrifices by which the Theban ladies used to propitiate that goddess. Apollo and Diana, the children of Latona, resented this indignity, the former slaying the male children, and the latter the female. The grief occasioned by this calamity struck Niobe dumb, and deprived her of sensation. She is therefore said by the poets to have been turned into stone.

NIPHON the largest and most northern of the

Japan islands, extends 750 miles in length, and from 60 to 150 in breadth, and contains 55 provinces. A narrow channel separates the south-west part from Corea. Jeddo is the chief town and the metropolis of the empire. See Japan.

NISBET, Alexander, author of a "System of Heraldry," in two volumes folio, and embellished with plates, flourished about the close of the 17th and commencement of the 18th centuries. It is not a little remarkable, that of this gentleman, who exerted himself to perpetuate the names, families, genealogical connexions, and heroic achievements of his countrymen, there is no memoir extant. His work, however, is esteemed, in point of accuracy and research into antiquity, equal to any thing yet published on the subject of heraldry.

NISI PRIUS, in law, a commission empowering the judges of assize to try all questions of fact issuing out of the courts at Westminster that are then ready for trial by jury. This writ derives the name *nisi prius* from its first words, *nisi prius apud talem locum venerint.* All trials at law in the civil courts, and at the assizes, are tried by this process, and are consequently denominated trials at *nisi prius.*

NISMES, or Nimes, a large and flourishing town in the department of Gard in France. See Gard.

NITRE, or Saltpetre. See *Potash* under Chemistry, and likewise Geology.

NO, in ancient geography, a famous city of Egypt, supposed to have been the same with Thebes. See Egypt.

NOACHIDÆ, a name applied by the Rabbins to all mankind who are not of the chosen race of Abraham. It is asserted by the Rabbins, that to Noah and his sons were given certain precepts by God, the observance of which, as they comprised the natural rights common to all men, would suffice to save them. Regarding the precepts of the Noachidæ, which are seven in number, no mention is made in the sacred writings, nor in those of Josephus or Philo; nor does it appear that the fathers were acquainted with them. They therefore appear to be spurious, especially as additions have been made to them by the Rabbins. No stranger was permitted to dwell in the country of the Hebrews, who would not conform to the general precepts of the Noachidæ.

NOAH, the patriarch, who with his family survived the deluge, and became the second father of the human race, was the ninth from Adam the son of Lamech, and was born A.M. 1056. See Ark and Deluge.

NOBILIARY, a record of the noble families in any nation or province. Such are Caumartin's Nobiliary of Provence, and Choriere's Nobiliary of Dauphine.

NOBILITY, from the Latin *nobilitas,* denotes that dignity which elevates any person above the condition of a commoner. In ancient Greece, the nobility were the descendants of such heroes as were celebrated for patriotic achievements, and they were privileged to wear golden grasshoppers in their hair. Among the Romans, nobility was at first restricted to the Patrician order, but afterwards extended to those whose ancestors had enjoyed some curule office. Their insignia consisted of the figures of a half moon, which they wore on their shoes. The origin of nobility in Europe is by some traced to the Goths, who, after they had seized a part of the country, conferred titles of honour on their military leaders. In Britain, the right of peerage seems to have been originally territorial, or connected with certain possessions, as lands, castles, manors, and the like. It is now conferred only by the king, and is restricted to those dignities above knighthood, which ascend through the several degrees of baron, viscount, earl, or count, marquis, and duke. See Heraldry.

NOBLE, a money of account of the value of six shillings and eightpence Sterling. See Money.

NOLLET, John Anthony, a celebrated French philosopher, was born at Pimbre, in the diocese of Noyon, in the year 1700. Though he took clerical orders, in compliance with the wishes of his parents, his strong predilection for natural philosophy induced him afterwards to devote himself almost entirely to the study of the sciences. He soon became known to different philosophers, who greatly respected him on account of his talents. Having visited England in 1734, he was admitted a member of the Royal Society, and a few years afterwards he was received into the Royal Academy of Sciences in France. He was in 1738 appointed first professor in the class for experimental philosophy at that time established by Cardinal Fleury; and two years afterwards he was invited to Turin by the king of Sardinia, where he delivered a course of lectures before the royal family. About the year 1744, Nollet was called to Versailles to instruct the dauphin in experimental philosophy; and so completely did he gain the esteem of his royal pupil, that till his death the prince continued to shew him marks of the strongest attachment. Having heard much regarding the medical virtues ascribed to electricity, he examined the subject with care, and became convinced that most of the facts appealed to were either deceptions or great exaggerations. The king having instituted a class of experimental philosophy in the Royal college of Navarre, gave the professorship to Nollet, and afterwards appointed him preceptor in physics and natural history to Enfans de France. He likewise obtained the professorship of experimental philosophy in the school of artillery established at La Fere in 1757. After rendering many important services to the literary world, he died at Paris in 1770, in the 70th year of his age. Several papers were by this able philosopher contributed to the Memoirs of the Academy of Sciences, besides which he was the author of *Leçons de Physique Experimentale, Recueil de Lettres sur 'l Electricite, Essai sur l' Electricite des Corps, and L. Andes Experiences.*

NOMENCLATURE, Nomenclatura, is a regular compilation of such words with their significations as are of most general use, designed to assist the learner in the attainment of the language. The term is more especially applied to the technical words by which the objects of any science are denominated: the present language of chemical science, for example, is generally called the New Chemical Nomenclature.

NOMINALISTS, or Nominals, a sect of school philosophers, so styled in opposition to the Realists, because they maintained that words and not things were the object of dialectics. This sect commenced about the end of the eleventh century, and at first professed to follow Porphyry and Aristotle. The opposition of Albertus Magnus, Thomas Aquinus, Duns Scotus, and other eminent men, afterwards brought the Nominalists into disrepute. In the fourteenth century, however, this sect was revived in France and Germany, through the instrumentality of William Occam or Ocham. The controversy of the Nominalists was deemed not unworthy of engaging the serious attention even of popes and monarchs. Pope John XXII. and his successors, exerted themselves to the utmost in opposing this sect; and Louis XI. at the instigation of the bishop of Avranches, issued in 1473 a severe edict against the Nominalists, ordering all their writings to be seized and placed beyond the reach of the people. The university of Paris, also by a public edict, solemnly condemned the philosophy of Occam. At present it is considered only as a subject of harmless speculation in metaphysics. The support which the celebrated Dugald Stewart has given to the opinions of the Nominalists, is reviewed in the lectures of his successor the late Dr Brown.

NON-AGE, the period during which a person is considered in law as incapable of performing certain acts. See MAJOR.

NON-CLAIM, in law, is usually applied to the period of five years, after which a party is barred by a fine. Where a person has a demand upon another, and does not, within a reasonable period, enforce his claim, he is precluded from bringing his action to enforce it; and where a creditor omits to make his claim upon a bankrupt's estate within a limited time, he cannot be received in afterwards. See LIMITATION.

NON EST FACTUM, in law, is a plea where an action is brought upon any deed, and the defendant denies the deed to be his whereon he is impleaded. The defendant may plead *non est factum* in every case where the bond is void; but where it is voidable only, he must shew the special matter.

NON PROS, in law, where the plaintiff in an action neglects to deliver a declaration for two terms after the defendant appears, or commits other defaults against the rules of law in any subsequent stage of the action, he is adjudged not to pursue his remedy as he ought, and a non-suit or *non prosequitur* is thereupon entered, when he is said to be nonprosed.

NON-RESIDENCE especially applies to those spiritual persons who are not resident, but absent themselves for the space of one month together, or two months at several times in one year, from their benefices or dignities, whereby they subject themselves to certain penalties according to the statute against non-residence, 21 Henry VIII. c. 13. But chaplains to the king, or other great persons mentioned in this statute, are exempted from these penalties whilst they attend those who retain them.

NON-SUIT signifies the voluntary dropping or termination of a suit in consequence of some error or informality. There is this advantage attending a non-suit, that the plaintiff, though he pay costs, may afterwards bring another action for the same cause, which, after a verdict against him, he cannot do.

NONCONFORMISTS is a term applied to such as do not conform to the worship established by law, and sometimes to such as attend no divine service at all. These, by certain statutes of Elizabeth and James I. forfeit one shilling to the poor every Lord's day they so absent themselves, and L.20 to the king if they continue such default for the space of a month, while those who harbour them in their houses are also liable to a fine of L.10 per month. In ecclesiastical history the term Nonconformists applies to such persons as dissent from the ritual of the established church, particularly the church of England, and in a general sense it comprehends all dissenters both Protestant and Papist. The origin of it may be traced to the reign of Edward VI. Of the fugitive congregations who took refuge in Germany from the inhuman tyranny of Mary of England, some followed the liturgy of Edward, and were called Conformists; others professed the Swiss method of worship as most agreeable to Scripture, and were therefore styled Nonconformists or Puritans. The auspicious succession of Elizabeth to the throne induced the exiles to return to their native country, into which they introduced the distinction that had divided them abroad. Having attempted to reform the worship and discipline of the church, and really ameliorated it in some respects, the queen issued the famous act of Uniformity by which all her subjects were commanded to receive the reformation and rules sanctioned by her as the supreme visible head of the church on earth.—The Puritans, on the plea of conscience, refused their assent both to her claim and to the rules established by her. They were afterwards unhappily divided into a variety of sects, some following the code of Geneva and others, originally Brownists, the modified Congregational or Independent plan. After the restoration of Charles II. the hopes of the Nonconformists were grievously disappointed, and the aspect of their affairs was suddenly changed. Charles subjected both the churches of Scotland and Ireland to the jurisdiction of bishops, and enacted that they should have the same ceremonies and discipline with the church of England. From that period until the reign of King William III. the Nonconformists, though they occasionally enjoyed short intervals of tranquillity, according to the varying spirit of the court and the ministry, were never free from perplexities and fears. But in the year 1689 their affairs took a favourable turn, when a bill for the toleration of all Protestant dissenters from the church of England (except the Socinians) passed in Parliament almost without opposition, and delivered them from the penal laws to which they had been subjected by the act of Uniformity and other acts of a similar nature, passed under the house of Stuart. This is called the Toleration act; in it the Corporation and Test acts were overlooked or omitted, and they consequently remain in force. See Neal's *History of the Puritans*, Burnet's *History of His Own Times*, and Mosheim's *Eccl. Hist.*

NONES, in the Roman calendar, the fifth day of the months January, February, April, June, August, September, November, and the seventh of March, May, July, and October. See Ides.

NONJURORS. The members of the Episcopal church of Scotland were so denominated for a long time, on account of their refusing to take the oaths to the present government; but the name is now obsolete, as the political ground of difference is ended and all penalties are removed.

NONIUS, an instrument so called from the inventor, Pedro Nonius, or Nunez, a professor of mathematics in Portugal. It is used for graduating the divisions on a scale, quadrant, &c. For the purpose of dividing each degree into very minute parts, 45 concentric circles are formed, the quadrants of which are divided into equal parts, the outermost consisting of 90, and the interior in succession decreasing by one, till the innermost present only 45. The index moving in the common centre, in passing over the degrees of the outermost, necessarily cuts some of the divisions of the included arcs, and thus the parts of a degree are found by calculation. See Vernier.

NOOTKA, or King George Sound, a bay on the western coast of North America, in west longitude 126° 38′, and north latitude 49° 32′, and lying on the west side of Quadra and Vancouver island. On the coast the land is high and level, but within the sound it rises into steep hills. The trees being chiefly Canadian pine and white cypress, are of large size. The rocks and borders of the woods are covered with strawberry, currant, and gooseberry bushes. The animals most prevalent are racoons, martins, and squirrels. In stature the natives are rather below the common standard. They cover their bodies with red paint, and ornament their faces with a black, a bright red, or a white colour, which gives them a singular appearance. They are very courteous, goodnatured, and docile, but quick in resenting injuries. A rattle and a small whistle are the only instruments of music employed by them. The manner in which they treat their children resembles that of the Chinese and Tartars, and they bind the head with a fillet, which gives it a conical form. Of both sexes the common dress is a flaxen robe ornamented with fur, over which is thrown a cloak of the same material, with a similar fringe. The skin of a bear, wolf, or sea otter, is frequently added by the men, and the head-cap usually resembles a flower-pot inverted, being formed of fine matting in the figure of a truncated cone. Their houses are mean hovels; and as there are only two villages inhabited, the population is supposed not to exceed 2000.

The first European discoverer of this bay, which, by the natives, is called Nootka, was Juan Perez, who, in 1774, called the port St Lorenzo. When Captain Cook anchored here in 1778, he adopted the name of King George sound. A company of British merchants, called the King George Sound Company, established a settlement on this bay in 1786, for carrying on a fur trade with China. It was, however, seized by the Spaniards in 1789, when the settlers were carried to Mexico and there set at liberty.

NORFOLK, a county of England, bounded on the north and north-east by the German ocean, on the west by Cambridgeshire and a small part of Lincolnshire, and on the south by the county of Suffolk. It is nearly of an elliptical form, extending 74 miles from east to west, and about 45 from north to south. The superficial extent is estimated at 2,092 square miles, or 1,288,320 acres.

*Aspect.*—The surface of this county is almost level. No hill of any considerable height is found throughout its whole extent. In the northern department there are, however, gentle swells and depressions, which agreeably vary the prospect. At the western extremity is a considerable tract of fenny land; and on the east a tract of marshes runs from the sea near Yarmouth to a considerable distance up the country. Several districts on the west, from Thetford northward, are nearly covered with heath, and have a dreary aspect, while cottages and small farm-houses, formed of wattle and dab, and covered with thatch, by no means tend to enliven the scenery.

*Soil and climate.*—Much of the soil of Norfolk, consisting either of marsh or light sand and gravel, is of little value. What is arable varies in its degrees of fertility. The soil towards the south-east is rich and deep; about Norwich and northward, it seems to be of easy tillage and extremely productive. The climate, on the whole is healthy, though in the fenny districts the air, as might be expected, is exceedingly damp, and the inhabitants are therefore subject to intermittent fevers. Owing to the prevalence of north and north-east winds, vegetation is greatly retarded, and the crops thrown later than those of the midland and less exposed districts.

The principal rivers are the Greater and Lesser Ouse, the Yare, the Wensum, the Bure, the Thyrn, and the Waveny. The Great Ouse rises in Northamptonshire, and divides Norfolk from Cambridge. The length of its course is supposed to be 60 miles, through 24 of which it is navigable for barges, and boats ascend it as far as Bedford. This river flows very gently, and forms a communication between Norfolk and no less than seven inland counties. Its mouth, which is known by the name of Lynn-deeps, affords good anchorage for Large vessels. About the equinoxes, especially the autumnal one, the Ouse is subject to great inundations, being forced back by the sea, which enters it with extraordinary fury, often occasioning great mischief. The little Ouse, which, together with the Waveny, rises on the south side of the county near Lopham, is navigable as far as Thetford, and joins the Great Ouse at Littleport. The Waveny forms through its whole course the boundary of Suffolk, and the Nen that of Lincolnshire. All these rivers and their tributary streams are well stocked with fish. The Bure abounds with excellent perch, and the Yare, which is next in importance to the Great Ouse, affords a species of fish peculiar to itself, called the *ruffe*. Most of the rivers rising in swamps, and flowing at a comparatively slow rate through a level country, form in their course numerous small shallow lakes or pools, which are provincially termed *broads* and *meres*, and are well stocked with fish, and much frequented by widgeon, teal, ducks, and other aquatic fowls. Of these meres, or meers, the principal occur in that district through which the Bure, the Wensum, and the Waveny have their course. The largest, Breedon-broad, measures three miles in length by one in breadth. The number of deep and smooth rivers supersedes in a great measure the necessity of canals, and only a short cut has been made from Wisbeach in Cambridgeshire to Outwell creek and Salters Load in Norfolk, to render more effectual the navigation of the Nen. The Wensum passes the city of Norwich, and partly environs it. The principal sea-port is at the mouth of the Yare.

*Natural history.*—The mineralogy of Norfolk presents almost nothing calculated to excite interest. There are no veins of coal, nor any quarries of useful stone. The substrata of the country seem to be clunch, chalk, gault, gravel, sand, silt, and peat earth. The clunch, which is a species of indurated chalk, covers all the more productive beds of rock, if such exist. It is sometimes used as a building-stone, but is more frequently burnt for lime. To the former purpose, the black flint, which is found in masses imbedded in the softer stratum of chalk, is better adapted; but the want of free-stone renders it necessary to resort to brick, which is more extensively used.

On the shore near Thornham, the roots and even trunks of an immense quantity of large timber trees are seen at low water,—the remains, no doubt, of a forest, which at some unknown period has been swallowed up by the waves. The accumulation of sand, forming banks off the coast, are bound together by the matted roots of what is called sea-reed grass, and are dangerous to mariners. The most noted are those which run parallel to the coast of Yarmouth, between which and the shore are the well-known Yarmouth roads, a deep channel, where vessels ride safely during tempestuous weather.

The animals of Norfolk differ but little from those of the other counties of England. Rabbits are extremely numerous, owing to the congeniality of the soil to their habits. The native cow is small, generally of a red colour, with short turned-up horns, not a good milcher, but hardy, and well calculated for barren pastures. The sheep are horned, and carry a fleece of about two pounds weight. The pig is a comparatively small, thin, bristled breed, but savoury, and very prolific. Hares, pheasants, and partridges are abundant. The pheasants are found in such numbers that they are often flushed on the stubble-grounds like partridges. The most remarkable species of bird in this county is the *otis tardi*, or great bustard, which is decidedly the largest of the British land-fowl.

*Agriculture and commerce.*—A hundred years ago half the country of Norfolk consisted of rabbit warrens and sheep walks; but since the middle of last century agricultural improvement has rapidly proceeded. The practice of fallowing was abandoned by the farmers of this county long before it was given up in other parts of the kingdom. The rotation of crops extends to six years, and is varied according to the nature of the soil. In 1793, it was computed that grain went annually out of the county amounting in value to about a million of money. The lighter arable lands produce barley in great abundance, and wheat is cultivated on the stronger soils. Turnips are perhaps more general here than in any other part of the kingdom, and form the basis of the Norfolk husbandry. They were first introduced into England as a field-crop in this county by Lord Viscount Townsend, who, in the time of George I. brought over some seed from Hanover, and recommended it to the use of his tenants. Much buck-wheat grows in the light soils, and is used for feeding swine and poultry. The fenny parts of Norfolk yield great quantities of butter, which is sold in London under the name of Cambridge butter. The rabbits, which still continue to burrow in the sandy wastes, and are particularly attended to in Methwold heath, and the heaths of Salthouse and Kelly, form a considerable article of trade. Poultry of all kinds is plentiful, and of superior quality. Norfolk turkies, owing to the mode of rearing and feeding them, are in high repute for the delicacy of their flavour, and vast quantities of them are sent to the most distant parts of the kingdom. They are commonly driven on foot to London, with large supplies of geese from the fenny districts.

Norfolk was distinguished as a manufacturing county long before it was known as an agricultural one. It is seven hundred years since Worstead became noted for the woollen stuffs which still bear its name, though it is now decayed into an inconsiderable hamlet. The surrounding district still continues to convert its wool, with various intermixtures of silk and mohair, into serges, crapes, shalloons, bombazeens, shawls, and a variety of fancy goods. The sea-port towns, of which Yarmouth and Lynn are the chief, furnish the inland counties with coal, wine, timber, and groceries, and receive in return large quantities of cheese, grain, and malt. Their ships also take a share in the Greenland fisheries, and visit the Baltic and the south of Europe. The graziers purchase large droves of Highland oxen, Scotch runts as they are called, which soon lose their rugged meagre appearance in the rich pastures on the east side of the county, and are fitted for the London market. About 20,000 bullocks are annually taken to Smithfield, three-fourths of which it is said come from Scotland, and are fattened in Norfolk.

*Population.*—This county is divided into 33 hundreds and 756 parishes. It contains one city, Norwich, the capital, and 32 market towns, and sends 12 members to Parliament. In 1821 the inhabitants were estimated at 344,368, one half of whom are engaged in agriculture.

NORFOLK, a county of Virginia contiguous to North Carolina, is 44 miles in length, and 22 in breadth, and is bounded on the north by the James, on the east and south-east by the Princess Ann county, and on the south-west and west by Nansemond. To the state of Massachusets, belongs a maritime county of the same name, which is 43 miles long and 20 broad.

NORFOLK, the capital of the county of the same name in Virginia, is situated on the east side of Elizabeth river, near its entrance into the estuary of James' river. It has a spacious harbour, and exports corn, tobacco, staves, &c. Among the principal buildings, are two churches, an academy, and a theatre. In 1776, this city was burnt down by order of the British government, but it is now the most considerable commercial place in the state.

NORFORK ISLAND, an island of the South sea, lying in south latitude 29° 12′ and east longitude 168° 16′. It is remarkably hilly, and covered by a thick forest. Along the coast, the cliffs are 240 feet high, and quite perpendicular. This island was discovered in 1774 by Captain Cook, who found it uninhabited. In 1788, a settlement was made here by a detachment from Port-Jackson in Sydney bay, on the south coast, but it has been since abandoned.

NORMANDY, a late province of France, bounded on the north by the English channel, on the west by the Atlantic, on the south by Perche and Maine, and on the east by Picardy and the Isle of France. While a province, it extended about 150 miles in length, and between 80 and 90 in breadth. It is remarkably fertile, abounding in all the productions of France, except wine, which defect is supplied by cyder and perry. The iron and copper mines of this place are not wrought to such an extent as they formerly were. The rivers are numerous, and among the sea-ports the chief are those of Dieppe, Havre, Honfleur, Cherburg, and Granville. Under the Romans, Normandy was the second Provincia Lugdunensis; under the Franks, it constituted a part of the kingdom of Neustria. The designation Normandy arose from its being ceded by Charles the Simple in 912 to the Romans. Rollo, their leader, was the first duke, and the province was held as a fief of the crown of France by him and his successors, till William, the seventh duke, conquered England in 1066, when it became a province of England. It was lost in the reign of King John, and reunited to the crown of France. At present, it forms the departments of the Channel, Calvados, Eure, Orne, and Lower Seine, with a small part of the Eure and Loire.

NORTH, Right Hon. FREDERICK, Earl of Guildford, well-known in British history as the prime minister who prosecuted the American war, notwithstanding its great unpopularity, and the powerful opposition made to his measures in Parliament. He was born in 1732, but did not succeed to the family estates till 1790, and is therefore chiefly known by the name of Lord North. Having succeeded the celebrated Mr Townsend as manager of the House of Commons and Chancellor of the Exchequer, he was, in 1770, made first Lord of the Treasury, on the resignation of the Duke of Grafton, and he continued in office till the formation of the Rockingham ministry, when preliminaries of peace began to be arranged with the colonies. He was a man of strong mental powers, a commanding orator, and allowed by the opposition themselves to be an able financier. Owing to the war, however, which chiefly signalized his administration, and the alleged influence of the Earl of Bute over the cabinet, he continued unpopular till he resigned the seals. His private character rendered him beloved by all who knew him. For many years he honourably sustained the office of chancellor of the university of Oxford. He died in the year 1792, and the officers of the university of Oxford, with a great body of the resident students, testified their respect for him by attending his funeral.

NORTH SEA, that part of the ocean which lies to the north of Great Britain and Ireland. Sometimes the name is applied to the German ocean, on that part of the Atlantic which is north of the Downs and mouth of the Thames.

NORTH-WEST PASSAGE. The discovery of a north-west passage into the South sea engaged the attention of navigators in the beginning of the sixteenth century. The Dutch actually made the attempt in 1594, but without success. The account of Captain Thomas James's strange and perilous voyage in the same undertaking, during part of the years 1631 and 1632, is very interesting. This officer, who was an Englishman, does not appear to have penetrated farther to the north than lat. 65° 30′, though he was absent between 16 and 17 months. He states, indeed, "that by the industry of our nation, those northern parts of America have been discovered to the latitude of 80 degrees and upwards;" but he only entered Hudson's straits himself, and delivers a most decided opinion that a north-west passage into the Pacific ocean does not exist. The most accurate and persevering of the old navigators was Baffin, who discovered that vast inlet, in the sought-for direction, which has since been denominated Baffin's bay. In subsequent times several enterprising navigators explored those seas, particularly the late Lord Musgrave, who in 1773 got as far to the north as 80° 50′. The Greenland whale-fishers have, however, sometimes gone much farther, and in 1754 a Captain Stephens advanced to 84° 50′. For a long time the prosecution of nautical discoveries in this part of the world ceased to be an object of ambition; but in 1817 the project was revived. The Arctic seas being represented by the fishers to be remarkably free of ice, the British admiralty were induced to send out an expedition. The objects in view were, 1st, To ascertain the practicability or impracticability of a passage by the north into the Pacific; and, 2dly, To advance science in general. It was argued that, if the region of the pole were occupied by an open sea, it might be possible to sail back circuitously over the pole itself, or that, if this should be found impracticable, it might be possible to proceed along the north-western coast of America into the Pacific ocean; and, lastly, that if neither passage should be open, still observations of much value might be made in geography, or on the effects of tides and currents of the sea, on changes of the atmosphere, variations of the magnetic needle, and the like. The legislature favoured the undertaking by drawing up a graduated scale of bounties for discoveries in the Arctic sea, according to the distance to which the adventurous navigators should proceed.

Accordingly, in 1818, two vessels, the Isabella and Alexander, proceeded, under the command of Captain Ross, as far as Lancaster sound, between 74° and 76° north latitude; but conceiving that he had fully ascertained that no passage was to be found there, he returned the same year, and published an account of his voyage, and of such scientific observations as he had made on it, some of which are of considerable value. Captain Parry, who had been the junior commander in this expedition, was select-

Northallerton.

ed to conduct a second, and he sailed with the Hecla and Griper in May 1819. This enterprising navigator proceeded, agreeably to his instructions, first to Lancaster sound, and was fortunate in discovering that the inlet so called was not properly a sound, but formed a connection with the Polar sea. He therefore continued to advance to the westward till he reached latitude 74° 26′ north, and west longitude 113° 16′, which entitled him and his crew to a bounty of L.5000 on the new graduated scale of reward. In September 1819, the two ships were laid up for the winter in a place called Winter sound, perhaps the coldest spot on the face of the globe, for in January 1820 they found the thermometer 49 below zero. They did not get out of this harbour till August 1820, and in November following returned to the Thames. This expedition, though it did not discover a communication with the Pacific, yet gave fresh reason to believe the discovery possible. Upon a full consideration, however, of all circumstances, it was deemed most probable that the passage would be found in a less northerly latitude, and that some of the inlets which Baffin had named sounds, might afford navigable communication with the Polar sea, and to the Pacific along the northern coast of America. On this principle Captain Parry went out again, with his brave crew, prosecuting the enterprize with the ardour which characterizes British sailors. They passed two winters in the northern regions, not such severe ones as in the former voyage, that of 1821 being spent in latitude 66° 11′, and W. longitude 33°, and that of 1822 in latitude 69° 20′, and longitude 81° 50′. They returned, after ascertaining the northern limit of the American continent; but the ice seemed to form an insuperable barrier against the wished-for passage. Among the discoveries by Captain Parry, was that of a tribe of Esquimaux who had never had any communication with Europeans. Their language, of which he acquired some knowledge by residing for several months among them, bears, he thinks, a striking resemblance to that of the Chinese. They are copper-coloured like other American Indians, and in a very rude state. They have no idea of war, nor any chiefs exercising even any species of civil authority. Polygamy and exchange of wives are common among them. Though well shaped, and of the ordinary stature, their persons are very offensive in summer, in consequence of never being washed. They possess a species of dogs covered with fine soft wool instead of hair, sixteen of whom Captain Parry brought home with him. The same officer was, soon after his return, engaged for a new voyage to the same regions, and sailed with the vessels Hecla and Fury, on 8th May 1824, fitted out with the greatest attention to the comfort and success of the expedition.

NORTHALLERTON, a borough and market town in the north riding of Yorkshire. Near it was fought the famous battle of the Standard, between the English and Scots, 1138, in which the king of Scots was totally defeated, with the loss of 10,000 men. It is situated on a rivulet which, a mile below, joins the Wisk, on the great road from Edinburgh to London, about 225 miles from the latter. Northallerton contains a population of 1300, and sends two members to Parliament.

Northamptonshire.

NORTHAMPTONSHIRE, one of the interior counties of England, which, from its irregular figure, touches on more of them than any other. It is bounded on the north by the counties of Leicester, Rutland, and Lincoln, on the east by those of Bedford, Huntingdon, and Cambridge, on the south by Buckingham and part of Oxford, and on the west by the latter and Warwick. Its greatest length is 65 miles, and its greatest breadth is 25. It contains an area of upwards of 600,000 acres.

*Aspect.*—The extensive forests and woodlands which are scattered over the county, and distinguish it from the neighbouring districts, add greatly to the variety and picturesque beauty of the scenery. Formerly a great part of Northamptonshire was occupied by the forests of Salcey, Whittlewood, and Rockingham. Rockingham, once the largest of the three, lies in the north of the county, and extending between Northampton and Stamford, measured about thirty miles in length and eight in breadth. It still occupies 10,000 acres. Salcey, in the south, comprehends 18,447, and seems to be best fitted for the growth of timber for the navy. Whittlewood, also in the south, occupies about 5424 acres. The surface of the county is considerably diversified, but is nowhere so irregular as to be unfit for the purposes of husbandry, every hill being cultivated, or kept in a state of profitable pasturage.

*Climate and soil.*—The climate differs in no material respect from that of the generality of the inland counties of England. It is, however, somewhat unhealthy in the north-east part, near Peterborough, which, being surrounded and intersected by rivers, is liable to inundations, and forms the commencement of the fenny tract, extending to the Lincolnshire washes. With this single exception, Northampton is regarded as a fine and pleasant county, and is accordingly noted for the number of mansions and country-seats which it contains. The soil is various, chiefly of a stiff loamy nature, in some places cold and wet, but on the whole fertile, and the products are, in general, the same with those of other farming counties.

*Rivers, &c.*—There are no hills of importance in the county; but the elevation of the whole above the neighbouring districts appears, from the fact that, while it receives not a drop of water from any other county, it sends forth streams in all directions to the German ocean, to the Irish sea, and to the Thames. The principal rivers are the Nen and the Welland, besides which it is partly watered by the Ouse, Leam, Charwell, and Avon. The sources of these rivers are denominated wells. The two first continue in the county till they become navigable rivers, and the Nen, in consequence of certain improvements, can be ascended as far as the city of Northampton. The Great Ouse rises at Ousewell, near Brackley, and soon entering Buckinghamshire again touches its parent county near Old Stratford. The Avon, which, like it, is but a rivulet when it issues from the county, rises at Avonwell, near Naseby, and flows westward into Warwickshire. The internal communication is further promoted by the Oxford and Grand Junction canals, which cross each other at Braunston, and continue in the county for a number of miles.

*Agriculture and commerce.*—About half the county is occupied in grazing; and cattle, both native and imported, being fattened for the London market, form the staple commodity. The most celebrated grazing land is the tract which extends from Northampton northward to the Leicester border. The forests furnish a range for the deer of the proprietors, and for the cattle of some adjoining parishes. Wool is provided for internal consumption, and the dairy is an object of considerable attention. Woad for the dyers is raised in considerable quantities. The farms in this county are comparatively small, and vary from L.100 to L.500 of rent.

The manufactures are comparatively trifling, and are chiefly concentrated about the capital. They consist of shoes, whips, lace, and woollen stuffs, and in these articles the trade is considerable. Except limestone, which abounds all over the county, the mineral products are few and of no great value, including neither coal nor metals.

*Population.*—This county is divided into 20 hundreds, and these again into 336 parishes. It contains one city, Peterborough, from which the diocese where it lies is denominated, three boroughs, Northampton, Brackley, and Higham Ferrers, eight other market towns, 551 villages, and sends nine members to Parliament. The population in 1821 was 162,483.

*Northampton,* the capital of the above county, is pleasantly situated on an eminence and slope, at the confluence of the two principal branches of the river Nen. It has two long streets, which cross each other at right angles, and from which branch off various smaller streets. The houses are handsome, and built chiefly of freestone. Near the centre is a large square, which is said to be the finest market-place in England. This city contains many remains of monastic and feudal times. In the 13th century it had a mint. But what chiefly gave importance to it in those days was the castle and fortifications, both of which have now nearly disappeared. The walls seem to have been of considerable strength, and they served for a promenade, to which the infirm and others were wont to resort for air and exercise. In winter, indeed, they were the best foot-path from one extremity of the town to the other. The streets are now well paved, as well as commodious and regular. St Peter's church, a curious monument of architecture, is still in good preservation, though it dates its origin from a period not much later than the Norman conquest. There were formerly seven parish churches in Northampton, of which four only now remain. The principal one, called All Saints, is in the centre of the town, at the junction of the great streets, and in its present structure does not belong to the Gothic, Grecian, nor any other regular order. Presbyterians, Baptists, Methodists, and Quakers have places of worship in this city. The Castlehill meeting-house is a large and commodious building, in which the celebrated Dr Doddridge continued to officiate for two and twenty years. Here are several charity-schools, a fine new jail, a general infirmary, a county hall, barracks, and a theatre. Not far from the town, on the London road, is a fine Gothic structure called Queen-cross, erected by Edward I. in memory of his queen Eleanor.

The principal manufactures of Northampton are boots, shoes, and lace. It is both a borough and corporate town. In the former capacity it sends two members to Parliament. The corporation consists of a mayor and two bailiffs, with such as have been mayors and bailiffs, a common council of 48 burgesses, a chamberlain, recorder, and town-clerk. The town was ravaged by the plague in 1637, seized and fortified by the Parliamentary forces in 1642, and nearly consumed by accidental fire in 1675.

NORTHERN LIGHTS. See AURORA BOREALIS and METEOROLOGY.

NORTHUMBERLAND, a county of England, which derives its name from its being situated north of the Humber, both Yorkshire and Durham having been at one time included under the appellation. It is bounded on the east by the German ocean, on the south by the county of Durham, on the west by that of Cumberland, and on the north by the detached part of Durham called Norhamshire and Islandshire.

*Extent, divisions, &c.*—This county extends about 65 miles from north to south, and 45 from east to west, and contains an area of 1,197,440 acres. It is divided into six wards,—and, with regard to ecclesiastical jurisdiction, into five deaneries, and 73 parishes. Northumberland is situated in the diocese of Durham, and has 12 market towns, of which Newcastle, Morpeth, Alnwick, the county town Berwick, Hexham, and North Shields, are the chief. It sends six members to Parliament, two for the county, two for Newcastle, and two for Morpeth. The population in 1821 was estimated at 192,965.

*Aspect.*—The surface of this county is greatly diversified. Along the sea coast it is nearly level; towards the middle district it rises into large swelling ridges, formed by the principal rivers; on the north it is skirted by the Cheviots, the highest of which is 2658 feet above the level of the sea, and has a morass on its summit; on the west, adjoining to Cumberland, is an extensive mountainous tract, where the hand of cultivation is rarely to be traced. The general appearance of Northumberland is rugged and hilly, but the sides of the hills are clothed with the softest verdure, while their summits are covered with heath, and where they open into vallies the eye is charmed with the most luxuriant vegetation.

*Climate and soil.*—As might be expected from the mountainous nature of the country, its exposure to the east, and vicinity to the sea, the climate is severe compared with that of other counties of England; but in those parts where the grounds are dry and cultivated, the air is very salubrious. The elevation of the morasses prevents their being so noxious as they would otherwise be. It has been remarked, that the cold easterly winds which prevail in spring, often prevent the bleak aspect of December from being wholly effaced in the month of May. From the month of June, however, vegetation is rapid, the trees being in a short time clothed with foliage and the pastures covered with the richest verdure. The summer of Northumberland passes into the autumn of the more southern counties, and winter sets in about the middle of November with uncommon severity. In the more elevated tracts the soil is spongy and barren; but in other parts it is sufficiently productive. Of the whole land in the county about two-thirds are or may be cultivated with the plough, the rest is wholly unfit for tillage. The finest tracts are in the south, and along the coast from Bamborough to within some miles of the Tyne. The tract around Belford, and that in the neighbourhood of Wark, and the vale of Hexham, are distinguished for beauty and fertility.

*Rivers.*—The chief rivers are the Tyne, Coquet, Aln, Till, and Blyth. Of these the Tyne is the most considerable. It is composed of two streams, which some suppose gave origin to the name, which in the Celtic signifies *double.* The South Tyne commences its course on the verge of Cumberland, the North Tyne takes its rise at the mountain called Fane-head, on the borders of Scotland and in the western part of the county, thence called Tynedale, and running to the south-east is united to the southern stream, near Nether-Warden, forming a large river, which passes Newcastle, and falls into the German ocean near Tynemouth. The Till, the Coquet, and the Aln, flow from the Cheviot to the German ocean. Ships of large burden can ascend the Tyne to Newcastle, and some of the other rivers are navigable for several miles above their mouths. The rivers of Northumberland afford a great abundance of salmon, and the smaller streams swarm with trouts. Along the coast, and on the islands adjacent to it, the fisheries are carried on to some extent.

*Agriculture,* &c.—Though the soil and climate of Northumberland are in general rather unfavourable, farming is very successfully carried on. Various systems of husbandry are pursued, but a preference is, by most of the farmers, given to drill-sowing rather than to broadcast; and manure, which is plentiful over all the county, is applied copiously. In the upland districts of the county, the rearing of cattle is much attended to. Great numbers of sheep are reared, the most common sorts of which are the Cheviot sheep, the Heath sheep, which are well adapted for the mountains, and the long woolled Dishly sheep, which fatten very early. The cow is generally of the breed called Dutch, and is so rapid in its growth that, at the age of three years and a half, the carcass, when fattened, weighs from 60 to 80 stones.

*Mines.*—The mineral wealth of this county is very considerable. There is a great abundance of lead ore in the western side of the county. In the mines of Allenhead about 5000 tons of ore are annually obtained, and from each fother of lead seven or eight ounces of silver is produced. Some other mines of lead are worked in the neighbourhood of Corbridge and Bamborough. Ores of zinc are contained in the lead veins, and throughout all the coal districts there is abundance of iron-stone inclosed in the strata of indurated clay. Pit-coal, which forms the staple commodity of Northumberland, occurs in immense beds dispersed under a surface of nearly 300 square miles, the greater part of which lies within a triangle which, at its corner, has Bywell, Tynemouth, and Alnemouth. In almost every part of the county limestone is very plentiful.

*Trade and manufactures.*—To the coal trade of Northumberland the inventions of Bolton and Watt, and the general improvement of the country, have given great vigour. It appears that, from the Tyne alone, no less than 12,490,707 tons of coal were exported between the 1st January 1802 and the end of December 1809. Besides the ships employed in this trade, a few are engaged in the exportation of the agricultural products of the country. The imports consist of Baltic or colonial goods, and the greater part of the manufactured articles which are consumed between the interior mountains and the sea. The chief sea-ports are Newcastle, Berwick, and Alnemouth, and there are a number of smaller harbours along the coast and on the banks of the navigable rivers. Of the internal manufactures of Northumberland, glass is the most prominent. On the river Tyne there are at present 28 glass-houses, the duties levied in which amount annually to about L.200,000. There are some pottery and foundery establishments in different quarters of the country. Several cotton-mills have been lately erected at Nether Witton; manufactures of woollen stuffs are carried on at Milford, Acklington, and Alnwick; and Hexham has been long noted for its manufacture of gloves. The county town has some establishments for working in gold and silver.

NORTHWICH, a manufacturing town of Cheshire in England, with a population of about 1400. It stands near the confluence of the Dane and the Wever. See Cheshire.

NORWAY, a kingdom of Europe lying between the 57th and 71st degrees of north latitude, and between 5° 20′ and 18° 20′ of east longitude from Greenwich, is bounded on the north and west by the Northern ocean, on the east by Russian Lapland and Sweden, and on the south by the Scaggerac sea. It extends about 950 miles from north to south, but its breadth, which is very unequal, varies from 30 to 240 miles.

*General aspect.*—The coast of Norway is studded with a great many small islands, which render the county inaccessible to the naval power of its enemies. In general the shore is bold, steep, and impending; insomuch that, close to the rocks, the depth of the sea is from 100 to 400 fathoms. There are several currents and whirlpools on the coast of Norway, the most celebrated of which is that called the Malstroem, the tremendous effects of which have been detailed not perhaps without exaggeration. Many creeks or gulphs run far into the land, and sometimes pass out so as to form straits. In these the ports are situated and the fisheries are carried on.

By all travellers who have visited Norway it is allowed to be a remarkably interesting country. The finest landscapes in the world beautify the banks of the Louven in Guldbrandsdale; and the prospects around Drontheim are not surpassed even by those of the bay of Naples. To the admirers of the picturesque no scenery can be more engaging than that of Norway. The elevated tracks are preferred by the Norwegians, because the higher the land is the more sun it receives; and hence farm-houses, corn-sheaves, cattle, and labourers, are observed in situations which seem to be inaccessible. Indeed the farm-houses appear to hang upon cultivated spots, one above another, till they reach the clouds. Some of the vallies of Norway are very narrow, others are of wider extent, and a few are so open as to resemble plains.

*Mountains.*—The mountains of Norway are numerous, and, in general, clothed with pines and firs. They commonly stretch in extensive chasms from north to south. Of these ridges, the most elevated is that called Dovrefieldt, which forms a part of the vast chain separating Norway from Sweden. Sneehattan, the loftiest of this group, rises to the height of about 8115 English feet. A considerable branch runs northwards from this part, forming the boundary between Norway and Swedish Lapland; and from the same central point another branch stretches to the south-east and forms the boundary between Norway and Sweden. By another branch, proceeding westward and then southward towards the Naze, Norway is divided into two principal regions called Sondenfieldts and Nordenfieldts. Several of these mountains have their summits covered with perpetual snow and ice; and from these heights are frequently precipitated into the plains immense avalanches, which, by their fall, produce dreadful devastation. The lofty chain of mountains which separates Norway from Sweden, for the space of 350 miles, forms a natural frontier to the two kingdoms.

*Rivers and lakes.*—Norway abounds in lakes and rivers, the former so extensive that they present the appearance of inlets of the sea. Many of the rivers have their origin in the Dovrefieldt. The Nidel, Laugen, Louven, Foemund, Drammenely, Mandalselv, and Glommen, which flow through the southern provinces, are very considerable rivers; but the Gula, Tana, Namsen, Alten, and Orkedal, which proceed towards the northern division, are of less volume, and soon reach the coast. The Glommen is the largest river in Norway. It rises in the lake Oresund, from whence it winds southward, and empties itself into the sea at Frederickstadt. The channel of this river is full of cataracts and shoals, and its highest cataract is that of Sarpen, more than 60 feet perpendicular, and at no great distance from its influx into the sea. These rivers are of great use in conveying timber to the sea-ports, and in working the saw-mills, which are very numerous; but they sometimes occasion great inconvenience and devastation by suddenly overflowing their banks.

The principal lakes are Rysvandet, Foelboe, Sneaasen, Sperillen; that of Mioss, about 70 English miles long, and 12 broad; near the middle of its extent, that of Foemund, about 30 miles in length and 6 in breadth, inclosed by lofty mountains; and that of Rands, about 40 miles long, but only two in breadth.

*Fisheries.*—The natives of Norway find employment and wealth in attending to the fisheries. Along the western coast, in particular, the fisheries are carried on to a great extent. At the station of Lofodden, during the months of February and March, about 20,000 persons, according to Von Buch's calculation, are usually engaged in fishing. Shoals of fish, particularly cod, ling, whiting, salmon, mackerel, and herring, frequent the lakes, rivers, and coasts of Norway. Immense quantities of cod are every year taken at the island of Vaage; and in taking them large nets are generally used, as being better adapted than lines and hand lines, which are chiefly employed by the poorer fishermen. Though, in a national point of view, this occupation possesses various advantages, yet so many persons are attracted to it, that the agriculture of the country is no doubt less attended to than it would be were there a greater number of hands to attend to agricultural pursuits.

*Mineralogy, &c.*—The principal chains of mountains in Norway, for the most part, consist of primitive and transition rocks. Of all the primitive rocks, gneiss seems to be the most abundant. The primitive rocks contain grey wacke, alum-slate, clay-slate, syenite, granite, amygdaloid, porphyry, basalt, and sandstone. Quarries of marble and slate are numerous; but no coal has yet been discovered. There are valuable mines of iron at Christiana, of copper at Roraas, and of cobalt at Fossum. The silver mines, especially those at Kongsberg, near Christiana, are remarkably productive. The whole number of mines in Norway is said to be 8000. To all these the right is retained by the crown, but various privileges are conferred on those who discover the mines and undertake to work them. No less than 2500 workmen are employed at the silver mines of Kongsberg, which mines, from the year 1623 to 1792, produced 25,130,573 rix dollars, but the clear profits were inconsiderable. In some years the copper mines of Roraas yield a profit of 149,162 rix dollars. The iron mine of Mioss yields annually about 4000 skeppunds of iron; that of Laurvig about 7000 skeppunds of bar iron, and 2000 of cast iron. From 40,000 to 50,000 skeppunds are annually produced from the whole iron mines of Norway. In the district of Rommerige there is a gold mine, the produce of which, however, has not yet covered the expense of working it. At Fossum the cobalt mines are very valuable. In one year (1792) they yielded 2817 quintals, valued at 38,709 rix dollars.

*Climate.*—The air of Norway is very pure, and the climate is highly favourable to health and longevity. In summer no traces remain of a northern climate, and the heat is sometimes excessive. The winter is frequently so moderate at Bergen, that the seas are open and practicable both to mariners and fishermen, excepting in creeks and bays. The climate of the western coast is considerably milder than that of the eastern. On the east of Norway the cold usually sets in about the middle of October with great severity, and continues till the middle of April. The cold is so intense in Finmarken, that all vegetation seems to expire under its power. In Norway the most violent winds are the south-east and northwest, which are accompanied with tremendous storms; but the winds from the north and northeast bring dry weather and purify the atmosphere. The longest day at Bergen consists of nineteen hours, and the shortest day six hours. Beyond Bergen, during a part of the year, the sun continues still longer above the horizon, but during another it is scarcely visible. In those regions where, in the winter season, the sun does not appear for several weeks, the *aurora borealis* and the whiteness of the snow serve to dissipate the darkness.

*Soil and productions.*—The proportion of soil fit for cultivation in Norway is very small, and the corn produced is scarcely sufficient to maintain one-half of the inhabitants. The southern coast is the most fruitful part of the country. The lower vallies are used for tillage and the higher for pasture. Owing to the judicious exertions of the patriotic societies in Norway, considerable improvements have, of late years, been effected in agriculture. In the south, and even in some of the northern provinces, gardening has made some progress. Different kinds of pulse, onions, pot herbs, and roots, thrive well. In Norwegian vegetation, trees,which often grow to a great size, form a prominent feature; and the best timber is produced in the provinces of Guldbrandsdale, Valders, Oesterdale, Helleland, Sognifiord, Saltan, and the lordship of Nedenes. A great part of the wealth of the country arises from the timber, especially pines and firs. Oak, elm, beech, and linden trees, alders, sycamores, aspens, hazels, and willows grow in the southern districts. Many of the forests belong to the crown, some are the property of individuals, and a few of them are, in a manner, common. In Norway the common fruit trees succeed favourably, and berries of various kinds, as raspberries, juniperberries, blackberries, gooseberries, solebar or sunberries, sloes, and corinths, are abundant.

The most productive districts of Norway are Vos and Sognedal in the government of Bergen; Jederen, Ryfylke, and Nedenes in that of Christiansund; Hadeland, Hedemarken, Toten Romerige, and Ringerige in that of Christiania; and Inderkerred and Nommedal in that of Drontheim. In some spots vegetation is astonishingly rapid. Barley is not unfrequently reaped six weeks after it has been sown; but oats are more generally cultivated. The turnip called kale-raby, which grows to a very large size, is deemed one of the most valuable productions for the support of cattle, and is likewise boiled for the table. Less attention, however, has been paid to this species of turnip since potatoes have been generally introduced into cultivation. Norway is better adapted for the rearing of cattle than for the culture of grain. It is from the cutting of timber for various purposes that the profits of the husbandman arise in most districts of this country.

*Animals.*—The bear, elk, lynx, wolf, and fox are the principal wild animals in Norway. Of the mouse called lemming there are immense numbers, which prove injurious to the fields through which they pass in their migratory excursions. Fire-arms, snares, and dogs are employed in thinning the numbers of brown, black, and white bears; and as the wolves are also extremely numerous, the destruction of these animals is rewarded by premiums from government. The toils of the peasant in destroying wolves, bears, lynxes, and other wild animals, is well rewarded by the skins obtained, especially lynxes, which bear a high price. Domesticated animals, such as the horse, the cow, the sheep, and the goat, are numerous, and of good quality; but hogs are not abundant, nor are poultry made an object of much attention. The sheep are of the same breed with those of Denmark, excepting the English breed, which has been introduced into some of the southern districts. Many of the horned cattle, which are generally of small size, are sent to the islands along the coast to pasture at liberty. They constitute the main wealth of the inhabitants in the more elevated tracts, while, in the lower districts, they form, in the usual manner, a part of the farmer's stock. The horses of Norway are of a small breed, but well proportioned, lively, and hardy. Many of them are never shod, and they are not unfrequently ridden with merely a cord fastened to a wooden bit. In climbing and descending the rocks they display considerable address, and when attacked by the bears and wolves, they defend themselves very courageously. Sea-mews and other fowl frequent several of the small uninhabited islands in immense numbers, for the purpose of breeding, and eagles are common in some of the northern islands. The eagles being remarkably ferocious, venture even to attack the oxen, and that sometimes not without success, but they chiefly devour lambs and smaller animals. The birds which frequent the lakes and the sea shore are caught for the sake of their down, which constitutes an important article of commerce; and in this hazardous pursuit the natives are accustomed to clamber among the rocks, and even to suspend themselves from the summits of fearful precipices. There are no game-laws in Norway for the restriction of hunting and fowling, as it is found expedient to encourage these, in order to prevent the rapid increase of wild animals.

*Divisions and Population.*—Norway is divided into the four governments of Aggerhuus, or Christiania, Bergen, Drontheim, and Christiansund, or Stawanger. To the first of these belong the provinces of Aggerhuus, Christiania, Hedemarken, Buskerud, Bradsberg, Laurvig, Smolehnene, Jarlsberg; and the towns of Kongsberg, Christiania, Bragernass, Stromsoe, and Friederickshald. To the second belong the provinces of Stavanger, Mandal, and Nedenes, and the towns of Stavanger, Arendal, and Christiansund. In the third are contained the provinces of Bergenhuus, Sondre, and Nordre Bergenhuus, and the towns of Bergen, Vossevang, Evindvig, Ous, Kinservig, Lindoos, and Manger. The fourth contains the provinces of Drontheim, Nordland, Romdal, and Finmark; and its chief towns are Drontheim and Christiansund. From the northern position and rocky soil of Norway, it is not populous in proportion to its extent. In some places, especially in Hedemarken, there are about 1000 inhabitants to the geographical square mile; but there are no more than 500 or 600 to the square mile throughout the southern provinces, and scarcely 20 or 30 in the northern districts. According to an estimate made in 1801, the whole population was 910,074, but since that period the population has been on the increase, owing to the peasants being more at liberty to marry than formerly.

*Manufactures, &c.*—The timber trade, the mines, and the fisheries are the principal sources of national industry in Norway; manufactures, and even the common trades, have made little progress among the natives, the generality of whom fabricate for themselves, in an ingenious manner, all the articles necessary in domestic life. In some of the towns, however, various manufactories are established. Soap-making, sugar-refining, and rope-making, are carried on to some extent, and in the preparation of iron a great deal of work is done. There is at Mioss an extensive foundery for casting cannon, and a manufacture of works in iron and steel. Salt and saltpetre works are established at Drontheim, linen is manufactured at Drammen, and flannel-cloths and carpets are made in the correction-houses. Earthen-ware and glass are made in different places, and great quantities of potash and soda are prepared. With foreign nations Norway has a considerable trade. The exports consist chiefly of copper, iron, lead, silver, alum, Prussian-blue, timber, and planks, horses and horned cattle, tallow, hides dried and salt, fish, butter, train-oil, marble, and mill-stones. The commodities imported are grain, salt, brandy, wine, linen, and various luxuries. A great internal trade is likewise carried on along the coast, especially in the gulph of Christiania and the adjacent bays, which in a great measure serve the purpose of canals. Impenetrable forests, deep marshes, and precipitous heights, obstruct communication very much throughout the inland tracts; but the principal roads have of late years undergone some improvement, and, from the horses being remarkably steady and well trained, the accidents that occur are comparatively few. Such is the state of the roads during the whole of April and the greater part of May, that all communication is completely interrupted. In summer the Norwegians travel with small Swedish cars, and in winter, which is the season of business, with sledges. As all intercourse is carried on by means of sledges during winter, the want of snow in that season is regretted as a serious privation.

Of the chief trading towns Christiania has most commercial intercourse with Britain, Bergen with Holland, and Drontheim with Ireland; and the balance of trade is considered as in favour of Norway. It is usual for the Norwegian traders to sail with their own produce to the Mediterranean, and obtain freightage for Hamburgh, whence they proceed to the Baltic, and load there with corn for their own ports.

*Inhabitants, &c.*—The Norwegians are tall, robust, and rather of fair complexion, with countenances flat, but expressive of energy. In their general appearance, those of the mountainous districts are peculiarly healthy; the natives residing on the coasts are the most hardy mariners in the world, being capable of enduring great fatigue and encountering the severest inclemencies of the weather. The Norwegian women are more handsome than those of Sweden, but in general the men are not so athletic as the northern Swedes. Owing to the various degrees of civilization and refinement of the inhabitants of this country, they have the appearance of an assemblage of different nations rather than that of one people.

Those who live in the more remote parts of the country still retain the primitive mode of life and style of dress; but the inhabitants of the towns, especially the sea-ports, have gradually undergone various alterations in their habits and general appearance, by means of their intercourse with other nations. Such, indeed, is the variety in dress and manners existing among the natives of Norway, that, in Christiania, an individual from one of the northern vallies appears very much like a foreigner. "The Swedes, Danes, and Norwegians assuredly do not differ more from one another than the inhabitants of various vallies who assemble from all parts to the annual fair. This is one of the most interesting spectacles for every stranger who visits Norway, and for every person who wishes to examine human nature, and to trace by what routes and associations man gradually advances in the progress of civilization." The ancient dress, as it is worn in some of the remote vallies, bears a striking resemblance to the uniform of the days of Eugene and Marlborough. The men's coats are usually made of a stone-coloured cloth, and are ornamented with red button holes, and white metal buttons. By the women of the lower order, a jacket is worn, with a shining black apron over their petticoat, and a turban handkerchief above the head, under which appears a clean laced mob tied below the chin. The inhabitants of the maritime parts of Nordland, who are chiefly engaged in the fisheries, observe such similarity in their dress that they have the appearance of being in uniform. By the peasants in the south of Norway, a white jacket is usually worn, and a scarlet bonnet; but the higher ranks there are apparelled in the English fashion.

The Norwegians are a brave and patriotic people, and are remarkably attached to the British. They are obliging, hospitable, and liberal in the highest degree. Frank and decided in their manners, they speak and act like free men; and even the peasants conduct themselves undauntedly though by no means disrespectfully, before their superiors. Indeed, the character of this people is far more interesting than might be expected in the remote latitudes of Scandinavia. In saluting each other, they open their hands, and by a cordial shake of the hand, they express, both to superiors and equals, their thanks for benefits received.

Peculiar modes of living prevail in the remote or country districts, but the diet of the inhabitants of the towns is not unlike that of other countries in the north of Europe. The bread of the Norwegians is usually made of oats and sometimes of rye, and, being baked extremely hard, and laid in a dry place, it keeps for years. The peasantry subsist on bread and a kind of pottage of barley or oatmeal, which is sometimes mixed with sour milk or with dried fish; besides which they occasionally make use of butter, cheese, milk, salt-meat, and game. It is customary, in cases of emergency, to adopt the *lichen rangiferus*, or rein-deer moss, as an article of food; and sometimes also the bark of the fir-tree is thus employed. These being carefully prepared, are ground and mixed in the flour of which bread is made. Though generally temperate and frugal in their habits, the peasants of Norway indulge freely at festivals; and for Christmas, weddings, and other occasions, they are careful to provide a store of strong ale. They are, upon the whole, well clothed and lodged, and have a tolerable portion of the comforts of life. Like the peasantry of Italy, they generally sleep in a state of nakedness during summer.

In Norway wooden houses are more general than stone or brick buildings, but by order of government Christiania is wholly built of stone. The farm-houses have commonly a square hole at the top, which serves the double purpose of admitting the light and letting out the smoke. During winter, this hole (which is left quite open in the summer season) is covered with the membrane of some animal, stretched upon a wooden frame that fits the aperture, in order to transmit the rays of light, and it is occasionally removed by a long pole. The planks which cover the roofs of the houses are coated with the bark of the birch-tree, above which a covering of turf is laid that in summer yields grass and flowers. Cleanliness is a characteristic feature in the cottages of the Norwegians. The dwelling-houses in the towns have a remarkably neat appearance, and are not devoid of ornament. Norway contains very few public edifices besides the town-house and the ruined cathedral of St Olaf, in the town of Drontheim.

*Government, &c.*—The form of government established in Norway resembles that of Denmark. The kingdom being distributed into four governments, each of these is under the jurisdiction of a governor, and the general superintendence of the whole is vested in the governor of Christiania. Norway enjoys a particular code, called the Norway law, compiled by Grieffelseld at the command of Christian V. of Denmark, the great legislator of his country.

The principal sources of the revenue, drawn from Norway, are the land-tax, tithes of grain, fish, iron and copper, capitation-tax, customs, stamps on cards and paper, and a per centage upon income. Of late years the national militia has usually amounted to about 26,000 men, besides which there are some volunteer corps composed of the miners near the frontiers. By a new regulation, the peasants are taken into the army first at twenty, and then at twenty-two years of age, till the requisite number be made up, whereas formerly they were taken at any age below thirty-six. The Norwegian troops are greatly esteemed for their bravery, and are exceedingly attached to their country.

The laws by which landed property is regulated among the Norwegians are so singular, that we deem a minute extract from their law-books worthy of insertion.

*Of buying, redeeming, repurchasing, selling, and exchanging Udal (Odel) Lands.—(From the Laws of Norway,* "Kong Christian den Femtes Norske Lov," *published by authority, at Copenhagen, in* 1800.)

"1. He that purposes to sell his udal land, must summon to the assizes (*tinge*) all who are known to have udal claims upon it, and make open proclamation before the court that he wishes to sell such an udal land, which he names, offering it to them for ready money, within year and day, provided they are not in forfault, as hereafter set down; and this must be legally entered in the records of the court. He must then proclaim, or cause to be proclaimed, at the church, or in the church-yard, that he will sell the udal land, offering it to all his relations who have udal claims upon it, whether known or unknown, especially the nearest of kin, whether male or female, so that they may hear of it whether they be present or not; and this proclamation shall be held for a legal summons to purchase the property with ready money, within year and day, if they are *forfaultless.*

"2. This is the first *forfault*: If they have not money, the udal claimants must, within year and day, notify their forfault at the assizes, and have it legally recorded; and the notification must be repeated every tenth year. If the udal heir afterwards gets money within twenty years, he may not only redeem the udal from a stranger who has purchased it, but every udal claimant, who has given due notice according to his nearness of kin, may redeem it from one who is farther removed. If the udal heir is a minor, his guardians may give notice for him; and, if this is neglected, as soon as he is of the lawful age, he himself may notify his forfault, and afterwards repeat the notice every tenth year.

"3. When the relations, after legal summons, do not within year and day, as aforesaid, redeem the property, or notify their want of money, and afterwards repeat the notice at the end of every ten years, although they are not debarred by the second forfault hereafter specified, the property becomes irredeemable in the hands of him who has redeemed it, or of him to whom he has sold or alienated it; and it becomes the udal of the proprietor and his heirs, if it continues in his family long enough to give the legal prescriptive right, as is hereafter set down.

"4. The second forfault is, when the udal heir is abroad, or on the king's business, or sick, or *sore*, or can make oath that he knew not that the property was duly advertised for sale; in which case, he may redeem it within year and day after he comes home, or finishes the king's business, or gets well, or comes to know that the land was duly advertised, or if within the same year and day he gives notice that he wants money, and afterwards repeats the notice every tenth year, reckoning from the time that the property was sold.

"5. If the udal-man comes with money within year and day, or gives legal notice of his want of money within the twenty years, and will buy the land that was advertised, he may buy or redeem, at the price decerned by competent appraisers, both land, houses, and woods thereto belonging, even although another, not so near of kin, has bought them dearer; but, if mention is made in the brief (*deed of conveyance?*) of the sum for which it was *set* or sold, then it must be redeemed for the same sum, and compensation must be made for whatever has been laid out upon the property for proper and necessary ameliorations, according to the decision of competent umpires.

"6. If he who advertises his udal land will not sell it to the udal claimant who wishes to buy it within year and day after it has been advertised, then he must give the other, *Rofkiöb*, the fortieth part of what the land is worth.

"7. If he who has the land in his hands suspects that the udal claimant, who wishes to redeem it from him is purchasing for another, then he (the udal claimant) must make oath that he buys it as an udal for himself, and not for any other.

"8. If he who has bought an udal, sells it again, he must offer it to him from whom he purchased it, or to his relations, if it was their udal.

"9. If an udal land is wadset to the king, then the relations must redeem it within ten years, if they wish to retain it; but if it is mortgaged to any other, then, if the relations give notice, as aforesaid, they may redeem it within the twenty years.

"10. If any one wishes to redeem an udal land, which another who is *fremmit*, or not so near of kin as himself, has acquired by purchase or excambion, and claims it, then must he cause summon him who holds the land which he claims as his udal, or his guardians, if he is a minor, some time in autumn, when the hay and corn are got in, or, at the latest, before Yule, to meet him upon the land which he claims the Thursday next after Easter week, before the sheriff and eight umpires, who are not related to either of the parties, to hear the claimant's evidences, to shew what his claim of proximity is, and to receive from him the money which the land is judged to be worth by competent appraisers.

"11. If the person summoned then answers, that the land in question has been in the possession of him and his family for twenty years or more, then must he either make this appear by a legal instrument or deed of conveyance, or bring forward his prescription-evidences (*witnesses*) to shew when the land came into his family.

"12. But if the person summoned answers, that the land in question has been advertised to the relations, who have not given timely notice of their want of money, or had other legal forfault, as aforesaid, nor announced their claims every tenth year, and that the estate has been legally sold and made over to the possessor or his family, which he makes appear by deeds or witnesses; then, as aforesaid, the land may neither be redeemed from him, nor from any other to whom he may have sold it.

"13. If he who was summoned comes not to the land without legal forfault, then must the udal claimant, notwithstanding, bring his legal udal evidences; and the judge and umpires must afterwards adjudge the land to him, and so much money to the other as it is appraised at. This money must be produced to shew that it is forthcoming; but the claimant is to retain it as his own, in loan, till the other will accept of it.

"14. Children may redeem the udal land which their father or mother has sold during their minority, and that within ten years, reckoning from the time of their coming of age, namely, attaining the age of five and twenty years.

"15. When any one has sold the udal land which another wishes to redeem; the claimant has the option of demanding it of either party, the buyer or seller. The same holds good when udal or other lands have been sold, or wadset to another, redeemable within a stated period.

"16. When any one redeems an udal land, it mus be given up in the same state in which it was received; if it is ameliorated, a competent compensation must be made; and if it is deteriorated, the difference must be made up; the judge and umpires to determine between the parties, if necessary.

"17. He who possesses land which is *not* his *udal*, may both sell and make it over, by deed and seal, or before good witnesses, although he has not previously given legal notice of the sale."

*Ecclesiastical establishment.*—The religion of Norway is similar to that of Denmark. The clergy of all ranks in the country amount to about 500. With the reformed churches there are not a sufficiency of individuals connected to form regular communities. No Jews are permitted to reside in Norway.

*Education, Literature, &c.*—In endeavouring to increase the means of education in Norway, several patriotic societies have been successfully employed, and grammar schools are at length established in different villages. The elements of general knowledge are imparted to youth in the academies instituted at Drontheim, Christiania, Bergen, and other principal cities. A plan has been some time in agitation for the establishment of a university at Christiania. Notwithstanding the limited means of education in Norway, the common people are said to be all able to read, and the greater part of them to write. The Norwegians speak the Danish language, but many expressions of the ancient Gothic still remain in the remoter parts of the country. Since the middle of the eighteenth century, this country has produced several native writers, who are celebrated chiefly as historians and poets. Some of the clergy of Norway are distinguished by their scientific attainments. In Drontheim there is a society of the Sciences, and in Christiania a Topographical society. Each of these institutions publishes a periodical work; and the Topographical Journal of Norway, which is held in great repute, has a wide circulation.

The drama being a favourite amusement in Norway, a theatre is established in almost every town. In occasional concerts and operas, the Norwegians discover a considerable taste for music. Of their national dances, the two following are the most common; one called *polsk*, resembling a waltz, and another called *halling*, in which the performer, standing upon his head, kicks his heels about in the air.

*Historical notices.*—That the ancient inhabitants of Norway were of German extraction is affirmed by Pliny, Strabo, and Tacitus. They are supposed, however, to have been a colony of the *Basternd*, a powerful Gothic tribe. Of all the countries comprised in the ancient Scandinavia, Norway is the least known. Originally it was under a number of petty princes, but the whole country was united into one monarchy by Harold Harfager, A. D. 875. By Canute the Great the whole country was subjected to Denmark in the year 1028; and after many fruitless efforts on the part of the Norwegians to throw off the Danish yoke, the two crowns were united in 1380 by the marriage of Hager king of Norway with the celebrated Margaret. Distinct constitutions and codes of laws were, notwithstanding, still retained by the two kingdoms; and it was not till the year 1537 that Norway was formally made a part of the kingdom of Denmark. From this period Norway continued united to Denmark till the year 1814, when it was transferred to Sweden, in conformity to the arrangements made by the courts of Russia and Sweden, and afterwards acceded to by the British government. See Von Buch's *Travels* in *Norway*, and Clarke's *Travels in Norway, Sweden*, &c.

NORWICH, the capital of the county of Norfolk, and a bishop's see, is chiefly seated along the side of a hill, extending a mile and a half in length from north to south, and is divided into two portions by the river Wensum. For elegance and wealth it is one of the most considerable cities in Britain, and it is supposed to have arisen out of the ruins of the ancient *Venta Icenorum*. The name, being a slight alteration of the Saxon *Northvic*, Northern Town, was perhaps applied to it in contradistinction to some considerable place in the southern part of the kingdom in which this city stood.

Norwich is in great part encompassed by a wall, and it extends in length from north to south one mile and three furlongs, and in breadth from west to east one mile. Several bridges across the Wensum connect the northern with the southern portion of Norwich. The appellation of *a city in an orchard* has been bestowed on Norwich, from the circumstance of plots of ground well cultivated, and stocked with fruit trees, occurring very frequently in different parts of it. The streets are numerous, but generally narrow. Besides the cathedral, and those called the French and Dutch churches, there are, in the southern division of Norwich, 24 parochial churches, and north of the Wensum we find 10 more parish churches. Few of these 36 churches merit particular notice; but the cathedral is a magnificent edifice, consisting of a nave, with its side aisles, large northern and southern transepts, a choir surrounded at the east end, and girt by a continuous aisle, and a lofty steeple, which consists of a tower with four tall pinnacles, and surmounted by an octagonal spire. From the ground to the vane, this spire, which is only exceeded in elevation by another in Britain, namely, that of Salisbury, is 315 feet high. Except as respects the choir and the spire, the architectural character of this cathedral is chiefly Norman. The general air of the interior of this grand pile is singularly solemn. Besides the churches now mentioned, there are various other edifices devoted to religious purposes, belonging to Methodists, Presbyterians, Independents, Quakers, &c. Among the buildings appropriated chiefly to secular purposes, are the castle, city gaol, theatre-royal, guild-hall, assembly-house, infirmary, lunatic asylum, and a number of hospitals and schools. What still remains of the castle stands on a mound nearly in the centre of the southern division of Norwich. Some authors affirm that this Danish Norman fortress succeeded to one of much earlier date. The ancient dukes of Norfolk had a palace in Norwich, which, in modern times, has been converted into a work-house. Towards the north-western angle of the market-place is situated the city gaol; and not far from it stands the Guildhall, an edifice of some antiquity, wherein the civic and corporation business is chiefly transacted. The great market-place in the southern portion of the city forms a spacious quadrangular area, surrounded by buildings of a very diversified character. There are, besides this, a fish market, a madder market, and a hay market.

Norwich contains an excellent public library, and several banks and insurance-offices. The government of the city is committed to a body consisting of a mayor, recorder, steward, two sheriffs, 24 aldermen, of whom the mayor is one, 60 common-council men, a town-clerk, chamberlain, and other officers. In 1822 the population was estimated at 46,000.

The principal manufactures are bombazeens, for making which Norwich has long been famous, crapes, worsted damasks, fine camblets, shawls, flowered satins, fancy stuffs, cotton, thread-lace, and linen. In these valuable manufactures machinery is extensively employed. This city has a considerable trade, for which it is very advantageously situated a little above the junction of the Wensum with the Yare. From the sea-port town, Yarmouth, where the Yare enters the German ocean, it is navigable to within two miles of Norwich for boats and barges, which are thence floated up to the city by the Wensum. Great quantities of the manufactures are exported at Yarmouth, most of which go to London. The chief imports are coal, fish, oil, and wine. See *Beauties of England and Wales*, Vol. XI.; the *Norfolk Tour*; and Blomefield's *Essay towards a Topographical History of the County of Norfolk*.

NOSE, the primary organ of smelling. Among the Crim-Tartars, it is considered a piece of folly to have the nose standing before the eyes, for which reason they break the noses of their children while young. In Tartary those who have very small noses are deemed beauties. The Chinese likewise approve of small noses. In most other countries, however, large noses are preferred.

NOSOLOGY, a term derived from the Greek, signifying *disease* and *discourse*, and considered as synonymous with pathology. Medical writers now apply it exclusively to a methodical arrangement of diseases, after the manner of the classification adopted by natural historians.

NOTARII were certain persons employed by the Romans to take notes of the proceedings in their courts of judicature. They likewise attended the prefects to transcribe for them. The *notarii domestici* were employed in keeping the accounts of the Roman nobility. When the empire became Christian, notaries were appointed for ecclesiastical affairs.

NOTARY-PUBLIC, a person duly appointed to frame short draughts of contracts, obligations, charter-parties, or other writings. He attests deeds and writings, and likewise protests foreign and inland bills of exchange, and promissory notes.

NOTATION, in mathematics, the method of representing quantities, and the operations to be performed on them, by arbitrary signs or characters.

NOTTINGHAM, the capital of the county to which it gives name, is a large and respectable town, finely situated on a considerable eminence called the Dolorous Hill, from the tradition that a great slaughter of the Britons was here made by King Humber. Its name is derived from two Saxon words, *snotting* and *ham*, signifying *cave* and a *dwelling*, in allusion to the caves anciently dug in the rock on which the town stands. Of the true origin of Nottingham, nothing is certainly known. In ancient times it was surrounded by walls and a ditch, though few traces of these now remain. This town possesses a considerable degree of neatness and elegance, and its position is almost in the centre of England. The streets are numerous, and some of them of great length, but narrowness is characteristic of most of them. The greater part of the houses are constructed of stone or brick in the modern style, and some are of ancient erection. The market-place, from its extent, and the buildings which range around it, is justly admired; and a highly useful edifice, called the New Exchange, is connected with it. There are many public buildings in Nottingham, the chief of which, besides the churches and various dissenting places of worship, are the town-hall, a spacious edifice, with the town prison on the ground floor, a theatre-royal and an assembly-room, the infirmary, a remarkably handsome and commodious building, the lunatic asylum, and a number of hospitals. Exclusive of the extra-parochial chapel of St. James', and the chapel of Sneinton, the churches of the establishment are St. Mary's, St. Peter's, and St. Nicholas's, and of these St. Mary's is the foremost in point of architectural elegance. In this church, which is apparently of the style that prevailed in the time of Henry VII. are a number of monuments of the earls of Clare and of the Plumptre family. St. Peter's is a handsome structure, adorned with a tall spire. The church of St. Nicholas is a modern brick-building, situated on the scite of the old church of the same name, which was pulled down by the governor of the town and castle, during the latter part of the reign of Charles I. because it stood near the castle, and might have become of service to a besieging army.

The education establishments of Nottingham consist chiefly of the free grammar school, where 60 boys are gratuitously taught English, writing and arithmetic, Greek and Latin; a national school, and a Church of England Sunday school. In the various Sunday schools, the number of children who receive instruction is said to amount to about 3000.

The population of this flourishing town has been increasing for many years. In 1811 it was estimated at 34,363. The corporation consists of a mayor, six aldermen, a recorder, two sheriffs, two chamberlains, and a common council, consisting of twenty-four burgesses. The town is represented in Parliament by two members, the choice of whom is vested in the corporation, freeholders, &c. Nottingham is one of the principal seats of the stocking manufacture, especially of the finer kinds, as those of silk and cotton. Various malt-houses, breweries, tanneries, and dying and bleaching works are established; likewise several mills for spinning silk and cotton, as well as for twisting. Nottingham being favoured by the Trent navigation and several vicinal canals, has a very considerable trade.

The present castle of Nottingham is merely a modern chateau, and is not situated within the town. It is, however, a striking object, and occupies the scite of an ancient fortress erected by William the Conqueror, and improved by Richard III. and Edward VI. In 1676 it was finished by the Duke of Newcastle at an expence of L.16,000. The park adjoining to the castle consists of 130 acres, and is worthy of notice on account of its caves, which are very curious, although greatly injured, and comprehend a chapel or oratory, wherein vestiges of ancient paintings are still discernible. Antiquarians are not a little divided in opinion regarding these curious monuments. See Leland's *Itinerary*, and the *Beauties of England and Wales*.

NOTTINGHAMSHIRE, an inland county of England, bounded on the north by Yorkshire, on the south by Leicestershire, on the east by the county of Lincoln, and on the west by that of Derby. It extends about 50 miles in length, and 27 in breadth, and contains an area of 535,680 acres. It lies in the diocese of York, and sends eight members to Parliament.

*Aspect, &c.*—This county presents an agreeable inequality of surface; and is well wooded, and watered with numerous streams. In the western district is situated the extensive forest of Sherwood, celebrated in the legendary story of Robin Hood, but which has at length lost the greater part of its sylvan decorations. The *Wolds* in the southern district constitute a range of high open country, and form a remarkable contrast to the close and beautiful vale of Belvoir. Towards the south and east the soil consists principally of clay, but towards the west it is sandy. Besides being highly favoured by the nature of the soil, Nottinghamshire enjoys an extremely dry and salubrious climate, and seed-time and harvest occur here almost as early as in the most southern parts of the kingdom.

*Rivers and canals.*—The Trent, which is navigable for large vessels as far as Gainsborough, is the principal river. It originates in Staffordshire, enters Nottinghamshire on the south-east, and passes the county town, whence it proceeds to Newark; and, continuing its course after quitting the county at Heck Dyke, empties itself into the Humber. The Idle, Soar, Lene, and Erewash, are branches of this river, all of which, together with the canals, are well adapted for the purposes of commercial intercourse. The principal canals are the Nottingham, the Grantham, the Chesterfield, and the Idle river canal.

*Natural history.*—A considerable tract of land in this county is occupied with limestone and coal, and freestone and marle are likewise plentiful. Gypsum, or alabaster, is found in great abundance near Newark, and converted into plaster of Paris. These mineral productions are a source of considerable wealth to the county, and have a favourable influence on its agriculture, by means of the various traffic to which they give rise.

In the rural economy of Nottinghamshire there is nothing very remarkable. Wheat, rye, barley, oats, beans, and peas, are generally cultivated. In the central parts of the county a great deal of hops is produced. Besides the raising of grain, which chiefly occupies the industry of the husbandman, grazing is an object of attention. A species of oats, called skegs, and which affords a sweet nutritous food for horses, is peculiar to this county. In almost every district, great numbers of sheep are bred; but, except on the banks of the Soar, where cows are reared for the dairy, there are comparatively few cattle in Nottinghamshire.

*Divisions, &c.*—This county is divided into six hundreds, which include 160 parishes; the market towns are nine in number, and the hamlets 450. By the returns of 1821, the inhabitants were found to amount to 186,873. Owing to the subdivision of farms, and other causes, the poor are said to be in a tolerably comfortable condition.

*Trade and manufactures.*—Besides the manufacture of stockings, for which the town of Nottingham has been long celebrated, various other manufactures are carried on in this county to a considerable extent. These consist chiefly of preparations of silk, of thread, and British lace. Upwards of thirty cotton-mills have been erected within the county. Some manufactories of sail-cloth are established, and dying and bleaching are extensively carried on both at Nottingham and Newark. Malt is manufactured at Mansfield, Newark, and Nottingham, and gives rise to another branch of occupation, that of brewing. The ales of this county are deemed nearly as good as those of Burton.

By means of an excellent inland navigation, the trade of Nottinghamshire is greatly facilitated, and, from the extensive traffic carried on in this county, thousands of the inhabitants find lucrative employment. The exports are, coals, salt, lead, copper from Derbyshire and Cheshire; Staffordshire-ware, lime, earthen-ware, pig iron, and cast-metal goods; oak, timber, and bark; stockings and sail-cloth: and the chief imports are timber, iron, hemp, flax from the northern parts of Europe, great quantities of flints from Northfleet and other chalk pits in the vicinity of the Thames, for the use of the potteries in Staffordshire; cotton wool, &c.

NOVA SCOTIA, a British province of North America, which formerly included the province of New Brunswick. It is about 300 miles in length, and 80 in breadth, and is bounded on the north east by the gulph of St Lawrence, on the south and south-west by the Atlantic, and on the west by the bay of Florida and the province of New Brunswick. Nova Scotia is divided into eight counties, which are subdivided into townships, and the chief towns are Halifax, (already described in the order of the alphabet,) Pictou, Liverpool, Lunenburg, Barrington, Argyle, Yarmouth, Digley, Annapolis, and Windsor. Of the province the whole population is about 88,000, the great body of whom are of British origin. In almost every town there is a small school, and each mission has a schoolmaster, who receives a salary from the Society for the Propagation of the Gospel.

Nova Scotia was almost a continued forest when the colony was first established. Its surface is diversified with hills and valleys, and some of the hills are covered with hard wood of various kinds. The chief rivers are the Annapolis, the Shubenacaddie, and the Pigaquid. Vessels of 400 tons go up to Windsor at high tides, and those of 100 tons five miles higher. There are some considerable lakes in Nova Scotia, and many fine bays, the largest of which is the Bay of Fundi, stretching 150 miles below New Brunswick and Nova Scotia.

Amongst the natural productions of the country are iron, copper, limestone, gypsum, and freestone. Birch, beech, and maple, different sorts of spruce, and likewise numerous herbs and plants not common to England, are abundant in all parts of Nova Scotia. The animals most prevalent are deer, beavers, and otters, wild fowl, and all manner of game; and many kinds of European fowls and quadrupeds which have been brought here thrive very well. The south-west coast is extremely productive of grain; but the greatest appendage of Nova Scotia is the Cape Sable coast, along which there is one continued range of fishing-banks and convenient harbours. Nova Scotia was ceded to Great Britain by the treaty of Paris in 1763.

NOVA ZEMBLA, a considerable island in the Frozen ocean, in the Russian government of Archangel, from which it is separated by Waygatz shoals. Its length is 540 miles, and breadth 200. This island, which stretches from 69° to 76° of north latitude, is almost entirely desolate, being chiefly occupied by white bears, white foxes, rein-deer, and elks. In the interior have been found pit-coal, asphaltum, and a salt lake. Nova Zembla is frequented by fishermen from Archangel and Mezen, for the purpose of obtaining whales and walrusses, and killing the bears and foxes for the sake of their furs. This island was discovered by the English in *1553*; and has been since visited by vessels engaged in the discovery of a north-east passage.

NOVARA, an ancient town of Italy, in the duchy of Milan, capital of the Novarese, is situated 25 miles west by south from Milan, and contains 17 churches besides the cathedral. In past times this place has sustained several remarkable sieges.

NOVATIANS, Novatiani, a sect of heretics, so denominated from its leader Novatian, a priest of Rome. It arose about the close of the third century. The doctrine of this sect, that *the church had it not in its power to receive sinners into its communion, as having no way of remitting sins but by baptism, which once received could not be repeated,* was grounded on the opinion of St Paul,—" It is impossible for those once enlightened, and who have tasted the heavenly gift, if they fall away, to renew themselves by repentance." This rigorous doctrine was, in process of time, moderated, so that absolution was only denied to egregious sinners; and the Novatians proscribed Novatian and Novatus, their two leaders, not for refusing communion to penitents, but for maintaining that the church could not remit sins.

NOVEL, a narrative of a fictitious nature, written in prose, comprising a series of remarkable and entertaining events in ordinary life, and of which the object is to amuse and instruct, by exhibiting the happiness and misery of private life, and, above all, the baleful effect of the passions when improperly indulged. This species of composition differs from the romance. In the former the rules of probability are or ought to be strictly observed, whereas in the latter the events which lead to the catastrophe are usually so extravagant as to exceed nature and probability. (See Romance.) The novel which took its rise from the old romance has been censured for insipidity, no less than its parent was for ridiculous extravagance. Though the great bulk of novel writers, however, have been unsuccessful in this species of writing, there are not a few who have succeeded in it to admiration.

The earlier writers of novels, in their attempts to picture life, embodied the most absurd and fanciful conceptions of the characters and manners of mankind; hence their heroes and heroines appear elevated far above the frailties and the necessities of human nature. But in course of time such visionary virtues ceased to please, and the exhibition of a general view of society next called forth the intellectual energies of novelists. The *Gil Blas* of Le Sage, and the *Tom Jones* of Fielding, represent characters which are rather specimens of the human race than particular individuals; and the chief merit of these highly popular works consists in the lively and familiar traits they afford of the workings of the human soul. To this species another very naturally succeeded, which consists in the copying, not of human nature in general, but of men of a particular nation or character. Thus the first class, which was mere theory, was improved into a generic description, which again suggested to the novelist a more distinctive classification; and the characters of the more popular novels of later times are not, in the abstract, *men*, but Scotch, English, Irish, or French. Respecting the modern novels of this class it may be remarked, that though they are, upon the whole, less comprehensive and sublime than their predecessors, they are by no means inferior to them in interest and utility. By the perusal of Gil Blas, Tom Jones, or Peregrine Pickle, none certainly was ever improved in virtue or manners; but not a few have benefited by the Tales of Fashionable Life, the Cottagers of Glenburnie, and other productions of a similar character.

In as far as utility constitutes merit in a work of fiction, it were well if publications of this nature were of a tendency more favourable to religion and morals than the generality of them really are. To delineate nature strikingly is, no doubt, a great excellence in literary compositions; but it is of infinite importance that an author exhibit such views only as are calculated to interest the heart in behalf of virtue. "If the world be promiscuously described," says Dr Johnson, "I cannot perceive of what use it can be to read the account; or why it may not be as safe to turn the eye immediately upon mankind, as upon a mirror, which shews all that presents itself without discrimination. It is, therefore, not a sufficient vindication of a character that it is drawn as it appears, for many characters ought never to be drawn; nor of a narrative, that the train of events is agreeable to observation, for that observation which is called *knowledge of the world* will be found much oftener to make men cunning than good. The purpose of these writings is surely not only to shew mankind, but to provide that they may be seen hereafter with less hazard; to teach the means of avoiding the snares which are laid by treachery for innocence, without inducing any wish for that superiority with which the betrayer flatters his vanity; to give the power of counteracting fraud without the temptation to practise it; to initiate youth, by mock encounters, in the art of necessary defence; and to increase prudence without impairing virtue. Many writers, for the sake of following nature, so mingle good and bad qualities in their principal personages, that they are both equally conspicuous; and as we accompany them through their adventures with delight, and are led by degrees to interest ourselves in their favour, we lose the abhorrence of their faults, because they do not hinder our pleasures, or perhaps regard them with some kindness for being united with so much merit." "In narratives," continues the same able critic, "where historical veracity has no place, there should be exhibited the most perfect idea of virtue; of virtue not angelical, nor above probability, (for what we cannot credit we shall never imitate,) but the highest and purest that human nature can reach, which, exercised in such trials as the various revolutions of things shall bring upon it, may, by conquering some calamities, and enduring others, teach us what we may hope and what we can perform." It is the business of the novelist, as we have already hinted, to interest the heart by a display of the incidents of ordinary life; in accomplishing which he must exhibit scenes that are probable, and record speeches that are natural. He must select objects, and cull from the mass of mankind those individuals upon whom the attention ought most to be employed. In proportion to his adherence to this rule, his narrative will be interesting, because every reader immediately perceives that, in circumstances similar to those of the hero or heroine of the tale, he himself may possibly be at some future period. In consistency with these remarks, Richardson's *Lovelace* is a character which should never have been delineated. In the graces of gaiety and the dignity of courage, in liberality without profusion, and perseverance and address, he everywhere appears pre-eminent; and that honour with which he protects the virtue of his "rose-bud," can only lead the reader to believe that another *Clarissa* might be in perfect safety were she to throw herself upon the honour of another *Lovelace*. In the composition of this extraordinary character, however, there is not one principle upon which confidence can securely rest, and *Lovelace*, whilst he is admired by the youth of both sexes, must excite the disapprobation of the moralist.

Richardson's *Grandison* and Fielding's *Allworthy* are perhaps the most perfect characters among the earlier novels, and without the moral defects with which they appear tinctured they could not have been objects of imitation. The character of *Clarissa* is likewise well drawn; for while she appears to possess every virtue that adorns the female character, she is not without some obvious failings.

Though written in prose, and even in a style not remarkable for elevation, a good novel has some claim to the appellation of a poem. But were such a production translated into metre, it would thereby lose much of its attraction, for the business of life is not transacted in pompous language, nor are the speeches of real lovers made in verse. In a poetical dress, the hero of Tom Jones would appear to no advantage. It has been well remarked, however, that had Aristotle seen Tom Jones, he would have pronounced it a poem perfect in its kind.

Many serious objections have been urged against the novel; and indeed some of these are so well founded, that it is a question if the circulation of the most esteemed novels has not done more evil than good to the cause of religion and morals. It is an undoubted fact that, exclusive of the contaminating influence which some works of this description are calculated to produce in the minds of the inexperienced and unwary, they are so little adapted to afford either instruction or rational amusement, as to merit the utmost contempt. Even some of the best novels are chargeable with exhibiting life as a series of incidents rather than a course of daily duties, and of inducing in individuals a distaste for the realities of their condition. By the powerful interest which books of amusement are calculated to excite, they are apt to divert youth from serious and useful studies. The same principle which actuates the philosopher in his investigations of the phenomena of nature, may in some measure be recognised in that extreme keenness with which individuals devour a new and interesting novel. But how vivid soever may be the emotions or feelings as acted upon by imagination, the pleasures connected with the acquisition of useful knowledge, are assuredly of a more exalted kind than the excitement produced by a work of fiction. Let it not be supposed, from these remarks, that we would entirely proscribe books of amusement. Novels may be, and have been, written worthy of the perusal not only of the young and gay, but even of the aged and the wise; and we decidedly concur with the author already quoted, "that these familiar histories may perhaps be of greater use than the solemnities of professed morality, and convey the knowledge of vice and virtue with more efficacy than axioms and definitions."

From the moral defects to which we have alluded, the Vicar of Wakefield is perhaps as free as any fanciful work of this nature. The peculiar merit of this piece consists in its display of the domestic virtues. The scenes it describes are remarkably entertaining, and in some of the passages there is a beautiful and irresistible pathos. The novels of Dr Moore, of Cumberland, Burney, Porter, Miss Moore, Hamilton, Edgeworth, and Opie, are among the more modern English productions, and they possess no small degree of literary merit. But those of one distinguished writer, who, by his splendid genius and learning, has greatly improved and adorned this department of literature, and who, by the interest he has excited, appears to excel all who have gone before him, deserve to be particularly noticed. For now ten years the public have been amused and delighted by the novels of the anonymous author to whom we allude. To his earlier productions, namely Waverly, Guy Mannering, The Antiquary, and Tales of My Landlord, have succeeded Ivanhoe, the Abbot, the Monastery, Kenilworth, the Pirates, Nigel, &c. In these novels are combined so many excellencies, that, as works of taste, they perhaps cannot be ranked too high. The stores from whence they are derived seem inexhaustible; and the number, beauty, and variety of the compositions are unrivalled.

The three novels, Waverly, Guy Mannering, and the Antiquary, were, as the author states, intended "to exhibit three different stages of society, embracing the age of our fathers, that of our own youth, and, lastly, that of the last ten years of the 18th century." The style, manner, and materials made use of, by the author of Waverly, differ materially from every thing of the kind belonging to his predecessors. In this opinion, we have the sanction of one of the most judicious reviewers of his productions— "character, interest, eloquence, something that hurries rather than leads you on, traits of feeling that melt, and strokes of humour that enliven the heart; all these he, in an eminent degree, possesses; with them he combines so curious and accurate a delineation of human nature, that, through the Scottish garb and the Scottish dialect, we distinguish the characteristic follies, foibles, and virtues which belong to our acquaintance and to all mankind." With all their good qualities, however, these novels are not without some defects. It has been justly remarked, that in several of them there is a striking degree of similarity, and an almost uniform selection of peculiar persons or situations. Three characters generally appear conspicuous;—a hero, passive and virtuous, who is involved in the chicaneries of a civil process, buffetted about, and exposed to the danger of a criminal prosecution, whose estate is perhaps mortgaged, and to whom the heroine is to be married; a hero remarkably fierce and active, who is to be subjected to a violent death when no longer wanted; and a fool, whose part it is to harp on one solitary string of humour throughout. It must, however, be admitted, that to avoid that sameness which is calculated to detract from the interest of a work of fancy, no small difficulty must be felt by an author whose productions of this kind are so numerous. "It seems admitted, though with a less approach to unanimity," says the Quarterly Review, "that his characters are superior to his plots; his humble to his higher life; his Scotland to his England; his tragedy to his comedy; and, in general, his earlier to his later works. While we have only to concur in these opinions, the task of criticism is easy and safe; but we only have been puzzled when we have heard the same quality brought forward as matter of praise and blame; when we heard mannerism attributed by some to him as a fault, and expressions which are really circumlocutions of it,—'that it is impossible to mistake his hand'—'that you may at once tell that all his works are from the same master,' employed as terms of high commendation."

In their remarks on Kenilworth, the scene of which is laid in Queen Elizabeth's court at London, the Edinburgh reviewers observe that "the great charm and glory of the piece consists in the magnificence and vivacity of the descriptions with which it abounds, and which set before our eyes, with a freshness and force of colouring which can seldom ever be gained except by observation, all the pomp and stateliness, the glitter and solemnity of that heroic reign. The moving picture of Elizabeth's entry to Kenilworth is given with such spirit, richness, and copiousness of detail, that we seem actually transported to the middle of the scene. We feel the press, and hear the music and the din, and descry, amid the fading lights of a summer eve, the majestical pacings and waving banners that surround the march of the heroic queen, while the mixture of ludicrous incidents, and the ennui that steals on their lengthened parade and fatiguing preparation, give a sense of truth and reality to the sketch that seems to belong rather to recent recollection than mere ideal conception. The account of Leicester's princely hospitality, and of the royal divertisements that ensue, the feastings and huntings, the flatteries and dissemblings, the pride, the jealousy, the ambition, the revenge, are all pourtrayed with the same animating pencil, and leave everything behind but some rival works of the same unrivalled artist. The most surprising piece of mere description, however, that we have ever seen, is that of Amy's magnificent apartments at Cumnor Place, and of the dress and beauty of the lovely creature for whom they were adorned. We had no idea before, that upholstery could be made so engaging; and though we are aware that it is the living beauty that gives its enchantment to the scene, and breathes over the whole an air of voluptuousness, innocence, and pity, it is impossible not to feel that the vivid and clear presentment of the visible objects by which she is surrounded, and the antique splendour in which she is enshrined, not only strengthen our impressions of the reality, but actually fascinate and delight us in themselves,—just as the draperies and still life in a grand historical picture, divide our admiration with the pathetic effect of the story told by the principal figures."

NOVEL ASSIGNMENT, in an action of trespass, is an assignment of time, place, &c. in a declaration otherwise than it is in the writ.

NOVEMBER, the eleventh month of the year, consists of 30 days, during the former 21 of which the sun is in the sign Scorpio, and about the 22d he enters Sagittarius. November was the ninth month in the Roman year instituted by Romulus. See *Chronology* under HISTORY.

NOVICIATE is a term applied in religious houses to the year of probation appointed for the trial of the religious, which is considered the civil deathbed of a novice, (*i. e.* a probationer, or one who has not made his vows,) who expires to the world by profession.

NOVOGOROD, VELIKI, an ancient city of Russia, finely situated on a plain at the north end of the lake Ilmen, and upon the river Volchow, by which it is divided into two parts. The quarter of St Sophia, on the left bank of the river, exhibits a remarkable air of fallen grandeur, and is surrounded by a rampart of earth flanked with old towers, forming a circumference of nearly a mile and a half. On the right bank of the river is the *Torgaraia*, or market-town. The Kremlin, or ancient palace of the czars, and the cathedral of St Sophia, are the principal buildings of Novogorod, and the population is estimated at 8000. This town had been gradually declining from the 15th century, when its glory was totally obscured by Peter the Great, who transferred the commerce of the Baltic to the new capital, Petersburg. East longitude 31° 19′ and north latitude 58° 31′.

NOX, in mythology, the most ancient of all the heathen deities, was the sister of Erebus, and the daughter of the first Chaos; and of these two, Nox and Erebus, Death (Mors) was born. She is usually represented with a speckled garment and black wings, and sometimes she appears holding her two children under her arms, one of which is black and the other white. She has likewise been described by some of the moderns as a woman veiled in mourning and crowned with poppies, and carried on a chariot drawn by owls and bats.

NUBIA, or NOUBA, a tract of country in Africa, bounded on the north by Egypt, on the east by the Red sea, on the south by Abyssinia, and on the west by Bornou. It is divided into two parts, Wady Kenous, and Wady el Nouba, in each of which a different language is spoken. The climate of Nubia is remarkably hot and dry; and excepting that part on the banks of the Nile, the country is sterile, sandy, and destitute of water. The natives subsist chiefly on a kind of grain called *dhourra*, the dry stalks of which supply their cattle as provender. The grounds are sown with this grain after the inundation of the Nile; and when dhourra harvest is ended, the soil is irrigated by means of water wheels turned by cows, to prepare it for barley, wheat, beans, and tobacco. Sometimes the ground is sown a third time with dhourra, and watered as before. The principal vegetable productions are the palm or date tree, the doum tree, a few vines, the cotton tree, the tamarisk, and the senna shrub. Nubia is famous for a powerful and docile breed of horses, and the wealthier inhabitants are provided with asses. There are few camels, except what belong to the merchants. The cattle consist of cows, sheep, and goats, and sometimes a few buffaloes are to be seen. Hares being numerous, are hunted by the Arabs with greyhounds. Partridges, wild geese, storks, a species of lapwing, the bird called katta, and the eagle, are the principal birds in Nubia. A large black species of beetle is commonly seen among the sand. The most important articles of commerce are cotton sent to Cairo, dates, and young date-trees, in return for which are received dhourra and coarse linen, or the Spanish dollar, which, among the Nubians, is rather an article of exchange than a current coin. The *moud*, or small measure of dhourra, is the common currency of the country, and some coins have been introduced since the Mameloukes took refuge here.

The whole population of this country is supposed not to exceed 100,000. The Nubians are lower in stature than the Egyptians, but well made, and with animated countenances. They manufacture a kind of coarse cloth mats for bedding, and earthen bowls and plates. The usual covering of the men is a linen shirt only, or the woollen cloak of the Egyptians, with a small white linen cap; and that of the women consists of linen rags, or black woollen garments; but the children go without any covering whatever. It is a prevalent custom in Nubia to besmear the head with fat, both as a protection against the heat of the sun and by way of ornament. The women are fond of wearing earings, bracelets, and other trinkets. In general, the men are armed with a short crooked knife, which is drawn in every quarrel. They moreover carry, upon any excursion, a long heavy stick, covered at one extremity with iron, or are armed with a long lance, and a target made of the skin of the hippopotamus. The houses of the Nubians are miserable hovels, built of mud, and covered with reeds, and are generally very low. Their bread, which is made of dhourra, is extremely coarse and ill tasted, and very little animal food is made use of by them. In the larger villages, palm-wine is a common beverage, and an intoxicating liquor, resembling beer, is made from dhourra or barley. The natives of Nubia are much attached to their native soil, and are a more undaunted race than the Egyptians. Their religion is that of Mahomet, and in their dispositions they are generally honest and obliging, though remarkable for a great degree of curiosity. For mercantile pursuits they seem to have no inclination. No mustachios are worn by the Nubians. It is customary for them to purchase their wives from the parents at a certain rate. By the laws of Nubia, the person who kills another must pay the debt of blood to the family of the deceased, and a fine to the governor; and there is a stated fine for every wound that one individual may happen to inflict on the body of another. The Nubians are fond of music, and generally amuse themselves with chess and some other games.

*Dehr*, or *Derr*, a village of the larger class, being the capital of Nubia, is the usual residence of the governors. It contains about 200 mud houses, and is principally inhabited by Turks, who are descendants of the Bosnian soldiers. *Dongola* and *Senaar* are the places in Nubia best known to Europeans.

This country is inhabited by the descendants of the Arab tribes, who invaded it after the promulgation of the Mohammedan faith. Two of these tribes, who were constantly at war with each other, occupied it for several centuries, but were at length subdued by the king of Dongola. The weaker of these two tribes having obtained from Sultan Selym the Great a body of Bosnian soldiers to assist them, some of the chief towns were taken possession of by the latter, whose descendants still remain under the appellation of Osmanli, or Turks.

The governors of Nubia bear the title of kashef, and to the pasha of Egypt they pay an annual tribute of L.120. Their revenue arises chiefly from a tax on every water-wheel used in agriculture, and a duty upon the dates which are exported. In levying the taxes, the governors tyrannize over the people in an unmerciful manner; and in the administration of justice, which is a lucrative concern to them, they uniformly favour the best payer.

Of the numerous antiquities of Nubia the most interesting is the temple of Ebsambal, or Ypsambul, which is cut out of the solid rock, and is in a perfect state of preservation. It has a superb front, the width of which is 117 feet, and the height 86 feet. M. Belzoni explored this temple so recently as the year 1817. In one of the recesses of the rock there are four colossal figures, which in size bear a proportion of two-thirds to the great sphinx at the pyramids in Egypt. See Legh's *Travels in Egypt*, Burkhardt's *Travels in Nubia*, and Belzoni's *Researches in Egypt*.

NUCLEUS, a term applied to the central parts of the sun, in order to distinguish them from the external parts, denominated the cortex or shell. By such as adopt this distinction, it is supposed that the nucleus is much more firm and compact than the cortex, and that they are separated by some intermediate space. Nucleus is also used to signify the head or body of a comet, in contradistinction to the beard or tail.

NUISANCE, in law, whatever unlawfully annoys another. A private nuisance is when only one individual or family is annoyed by the doing of any thing, as where a person stops up the light of another's house, or builds in such a manner as materially to incommode his neighbour. But a public nuisance is an offence against the public in general, either by doing what tends to the annoyance of the king's subjects, or by neglecting to do what the common good requires.

NUMANTIA, in ancient geography, a city of Hither Spain, celebrated for the twenty years sanguinary war which it maintained against the Romans.

NUMBER, a term derived from the Latin *numerus*, and signifying an assemblage of several units or things of the same kind. See *Number*, under MATHEMATICS. Various kinds and distinctions of number have been established by mathematicians. Broken numbers are the same with fractions. Cardinal numbers are those which express the quantity of units, as 1, 2, 3, 4, &c.; whereas ordinal numbers are those which express order, as 1st, 2d, 3d, &c. Compound number, one divisible by some other number besides unity; as 12, which is divisible by 2, 3, 4, and 6. Numbers, as 12 and 15, which have some common measure besides unity, are said to be compound numbers among themselves. Cubic number is the product of a square number by its root: such is 27, as being the product of the square number 9 by its root 3. All cubic numbers whose root is less than 6, being divided by 6, the remainder is the root itself: thus 27 ÷ 6 leaves the remainder 3 its root; 216, the cubic of 6, being divided by 6, leaves no remainder; 343, the cube of 7, leaves a remainder 1, which, added to 6, is the cube root; and 512, the cube of 8, divided by 6, leaves a remainder 2, which added to 6, is the cube root. Hence the remainders of the divisions of the cubes above 216, divided by 6, being added to 6, always gives the root of the cube so divided, till that remainder be 5, and consequently 11, the cube root of the number divided. But the cubic numbers above this being divided by 6, there remains nothing, the cube root being 12. Thus the remainders of the higher cubes are to be added to 12, and not to 6; till you come to 18, when the remainder of the division must be added to 18; and so on *ad infinitum.* From considering this property of the number 6, with regard to cubic numbers, it has been found that all other numbers, raised to any power whatever, had each their divisor, which had the same effect with regard to them that 6 has with regard to cubes. The general rule is this: "If the exponent of the power of a number be even, that is, if that number be raised to the 2d, 4th, 6th, &c. power, it must be divided by 2; then the remainder added to 2, or to a multiple of 2, gives the root of the number corresponding to its power, that is, the

2d, 4th, and root. But if the exponent of the power of the number be uneven, the 3d, 5th, 7th power, the double of that exponent, is the divisor that has the property required.

Determinate number is that referred to some given unit, as a ternary, or three; whereas an indeterminate one is that referred to unity in general, and is called quantity. Homogeneal numbers are those referred to the same unit, as those referred to different units are termed heterogeneal. Whole numbers are otherwise called integers. Rational number is one commensurable with unity; as a number incommensurable with unity is termed irrational, or a surd. In the same manner a rational whole number is that whereof unity is an aliquot part; a rational broken number, that equal to some aliquot part of unity; and a rational mixed number, that consisting of a whole number and a broken one; even number, that which may be divided into two equal parts without any fraction, as 6, 12, &c. The sum, difference, and product of any number of even numbers, is always an even number. An evenly even number, is that which may be measured, or divided, without any remainder, by another even number, as 4 by 2; an unevenly even number, when a number may be equally divided by an uneven number, as 20 by 5; uneven number, that which exceeds an even number, at least by unity, or which cannot be divided into two equal parts, as 3, 5, &c. The sum or difference of two uneven numbers make an even number; but the factum of two uneven ones make an uneven number. If an even number be added to an uneven one, or if the one be subtracted from the other, in the former case the sum, in the latter the difference, is an uneven number; but the factum of an even and uneven number is even. The sum of any even number of uneven numbers is an even number; and the sum of any uneven number of uneven numbers is an uneven number. Primitive, or prime numbers, are those only divisible by unity, as 5, 7, &c.; and prime numbers, among themselves, are those which have no common measure besides unity, as 12 and 19. Perfect number, that whose aliquot parts added together make the whole number, as 6, 28; the aliquot parts of 6 being 3, 2, and 1, = 6; and those of 28 being 14, 7, 4, 2, 1, = 28. Imperfect numbers, those whose aliquot parts, added together, make either more or less than the whole: and these are distinguished into abundant and defective. An instance in the former case is 12, whose aliquot parts, 6, 4, 3, 2, 1, make 16; and in the latter case 16, whose aliquot parts 8, 4, 2, and 1, make but 15. Plain number, that arising from the multiplication of two numbers, as 6, which is the product of 3 by 2; and these numbers are called the sides of the plane. Square number is the product of any number multiplied by itself: Thus 4, which is the factum of 2 by 2, is a square number. Every square number added to its root makes an even number. Polygonal, or polygonous numbers, the sums of arithmetical progressions beginning with unity. These, where the common difference is 1, are called triangular numbers; where 2, square numbers; where 3, pentagonal numbers; where 4, hexagonal numbers; where 5, heptagonal numbers, &c. Pyramidal numbers: the sums of polygonous numbers, collected after the same manner as the polygons themselves, and not gathered out of arithmetical progressions, are called first pyramidal numbers: the sums of the first pyramidals are called second pyramidals, &c. If they arise out of triangular numbers, they are called triangular pyramidal numbers; if out of pentagons, first pentagonal pyramidals. From the manner of summing up polygonal numbers, it is easy to conceive how the prime pyramidal numbers are found, viz. $\frac{(a-2)\,n^3+3n^2-(a-5)\,n}{6}$ expresses all the prime pyramidals.

NUMBER of **Direction**, in chronology, some one of the 35 numbers between the Easter limits, or between the earliest and latest day on which it can fall; *i. e.* between the 22d of March and the 25th of April. Thus, if Easter Sunday fall as in the first line below, the number of direction will be as on the lower line.

| | March. | | | | | | | | | April. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Easter-Day | 22, | 23, | 24, | 25, | 26, | 27, | 28, | 29, | 30, | 31. | 1, | 2, | 3, &c. |
| Number of Direction | 1, | 2, | 3, | 4, | 5, | 6, | 7, | 8, | 9, | 10, | 11, | 12, | 13, &c. |

and so on till the number of direction and the sum will be so many days in March for the Easter-day; if the sum exceed 31, the excess will be the day of April. To find the number of direction: Enter the following table with the dominical letter on the left hand, and the golden number at top; then where the columns meet is the number of direction for that year.

| G. N. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dom. Let. | | | | | | | | | | | | | | | | | | | |
| A | 29 | 19 | 5 | 26 | 12 | 33 | 19 | 12 | 26 | 19 | 5 | 26 | 12 | 5 | 26 | 12 | 33 | 19 | 12 |
| B | 27 | 13 | 6 | 27 | 13 | 34 | 20 | 13 | 27 | 20 | 6 | 27 | 13 | 6 | 20 | 13 | 34 | 20 | 6 |
| C | 8 | 4 | 7 | 21 | 14 | 35 | 21 | 7 | 28 | 21 | 7 | 28 | 14 | 7 | 21 | 14 | 28 | 21 | 7 |
| D | 19 | 15 | 8 | 22 | 15 | 29 | 22 | 8 | 29 | 15 | 8 | 29 | 15 | 1 | 22 | 15 | 29 | 22 | 8 |
| E | 30 | 16 | 2 | 23 | 16 | 30 | 23 | 9 | 30 | 16 | 9 | 23 | 16 | 2 | 23 | 9 | 30 | 23 | 9 |
| F | 24 | 17 | 3 | 24 | 10 | 31 | 24 | 10 | 31 | 17 | 10 | 24 | 17 | 3 | 24 | 10 | 31 | 17 | 10 |
| G | 23 | 18 | 4 | 25 | 11 | 32 | 18 | 11 | 32 | 18 | 4 | 25 | 18 | 4 | 25 | 11 | 32 | 18 | 11 |

Thus, for the year 1825: The golden number being 2, and the dominical letter B, the corresponding number of direction is 13, to which add 21, and the sum is 34; hence as this number exceeds 31 by 3, it follows that Easter-day happens on the 3d of April.

NUMBERS, a canonical book of the Old Testament, and the fourth book of the Pentateuch, is so called because it begins with an account of the *numbers* of the people. It comprehends a period of about 38 years.

NUMERAL FIGURES, or **Digits**, the ten Arabian or Indian characters, used by Europeans for expressing numbers, and performing calculations. These figures are said to have been first obtained from the Moors by Pope Sylvester II., who introduced them into France about the year 960, although they do not appear to have been applied to any useful purpose till about the year 1200. In this country no example occurs of the use of these figures in any ancient manuscript earlier than in some copies of Johannes de Sacrobosco, who died in 1256. The merit of the invention has by some been ascribed to the Greeks; and M. de Villaison maintains, that both the Greek and Latin arithmeticians made use of them long before the age of Boethius.

NUMERAL LETTERS, the seven capitals of the Roman alphabet, which are generally used for the purpose of numbering chapters and divisions in books, but were anciently employed in arithmetical calculations. They are, I, V, X, L, C, D, M.

NUMIDIA, an ancient kingdom of Africa, which comprehended the kingdoms of Massyli and Massaesyli, and was bounded on the south by Gætulia or part of Libya Interior; on the north by the Mediterranean sea, on the east by the river Tusca, and on the west by the Mulucha, which river separates it from Mauritania. The aborigines of this country were the descendants of Phut, who spread themselves all over the country, from between the lake Tritonis and the Atlantic ocean; but the district from the isthmus of Suez to that lake was peopled chiefly by the posterity of his brother Mizraim. This opinion is countenanced by Herodotus and Ptolomy, as well as by Mela and Strabo. Numidia is now occupied by the kingdoms of ALGIERS and BILEDULGERID,—which see.

# NUMISMATOGRAPHY.

Definition.

NUMISMATOGRAPHY is that branch of science which treats of coins and medals. The term is derived from *numisma*, a piece of money, and *grapho*, to describe; and consequently, in its literal acceptation, denotes a description of money.

*Importance of the subject.*—The study of medals is attended with considerable utility. By means of the decided evidence they afford, Vaillant, whose history of the kings of Syria was published in 1681 at Paris, succeeded satisfactorily in fixing the chronology and remarkable events in the history of the three ancient kingdoms of Egypt, Syria, and Parthia; and, since his time, other writers have availed themselves, in a similar manner, of the advantages resulting from this study. But their usefulness is not confined to history alone: In geography, natural history, architecture, and the fine arts, they render essential service. Thus the situation of ancient towns, the identical form of celebrated structures, the persons to whom busts refer, and other points, are readily determined. Indeed, a cabinet of medals is obviously a desideratum to the connoisseur; for it is fraught with valuable intelligence, which is conveyed with the most desirable brevity and precision. To the reader of the classics, likewise a knowledge of the Greek and Roman coins and medals must prove highly beneficial.

*History of Medals.*—It does not appear that medals were a very ancient object of scientific study, as no accounts of collections of them are given by any of the classic writers. Among the moderns, Petrarch was the first who applied himself to the Numismatic science. In the next age, a collection of coins was made by Alphonso, king of Arragon, which, though it consisted of all that could then be procured in Italy, was so small as to be carried about with him in an ivory cabinet. The collection of Cardinal St Mark, who obtained the pontifical chair in 1431, was very considerable; likewise the grand museum of Florence, established by Cosmo de Medici, contained a valuable collection. About the same time, a rich collection of coins was formed by Matthius Corvinus, king of Hungary. According to Mr Pinkerton, Angelus Politianus was the first writer who adduced medals in confirmation of ancient orthography and customs. Joannes Huttichius, who had access to the cabinet collected by Maximilian I. of Germany, published, in 1525, a book of the lives of the emperors, with portraits of them designed from ancient coins; but though this work has been supposed the first of the kind, the *Illustrium Imagines* of Andreas Fulvius, with portraits from medals, is said to have been published previous to it in 1517. In the sixteenth century, M. Grollier and Guillaume de Choul were great collectors. The study of medals is said to have commenced in the Low Countries in the early part of the sixteenth century; and about the middle of it, Hubertus Goltzius, a printer and engraver, was zealously engaged in pursuit of coins and medals preparatory to his valuable works on this subject. This latter writer states that, in his time, 200 cabinets of medals were contained in the Low Countries, 175 in Germany, 200 in France, and above 380 in Italy. Most of these, however, must have been of the class denominated caskets, rather than cabinets consisting of splendid collections.

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It is not known exactly when the study of Numismatography was first cultivated in Great Britain, though few countries, Italy excepted, have afforded so many coins and medals. Cambden, who, in all probability, must have possessed a collection, seems to be the first British author into whose works medals are introduced. In the seventeenth century, Speed's Chronicle was illustrated from Sir Robert Cotton's cabinet of coins. The celebrated collection of Gorlaeus consisted, as Scaliger informs us, of 30,000 medals and coins. The collection purchased by Archbishop Laud for L.600, and presented to the Bodleian Library at Oxford, amounted to 5500 coins. A rich cabinet of medals, collected by Daniel Nisum, was possessed by Thomas Earl of Arundel, a nobleman well known for the antiquities imported by him into Britain from Greece and Italy. Among the collectors enumerated by Evelyn, are the Dukes of Buckingham and Hamilton, Sir William Paston, Sir Thomas Fanshaw, Sir Thomas Hanmer, Ralph Sheldon, Esq. and Mr Seldon. King Charles I. had a noble cabinet, and that of Charles II. is noticed by Vaillant. But, since the time of Evelyn, the number of cabinets in Britain has been greatly augmented. Dr William Hunter's splendid collection, now belonging to the university of Glasgow, is surpassed by

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none in Europe, if we except that of Louis XVII. of France. Good collections are contained in the British museum and English universities, and in the Advocate's library, the Antiquarian society, and the universities of Scotland.

*Materials of Coins and Medals.*—The term medal being derived from the Latin *metallum*, signifies a piece of metal struck in form of a coin, and commemorative of any celebrated person or event. One of the two sides of a medal is denominated the face or head, and the other the reverse, and, on these sides are discovered the figure or type, and the legend or inscription. Medals were once used as coins, and, by this happy device every occurrence peculiarly remarkable in itself, or gratifying to the people, was at once communicated to all the members of a state or kingdom. Gold, silver, and various modifications of copper, were employed in the fabrication of coins and medals. The ancient medals were formed of less pure gold than what has been employed in modern coinage, and many of them were composed of *electrum*, or gold and silver, the latter being in the proportion of one-fifth part. But the medals of Philip I. of Macedon, and of Alexander the Great, as well as those of the Egyptian Ptolemies, were of fine metal, and even from the earliest times the coins of the Romans were comparatively pure. The process of refining gold is understood to have been well known to the Romans, and the countries of Dalmatia and Dacia furnished the greater part of the gold coined at Rome. As a proof of the perfection in this branch of metallurgy which the ancients had attained, we are informed by Bodin, that one of Vespasian's gold coins being melted by the goldsmiths at Paris, was found to contain not more than $\frac{1}{788}$ part of alloy. The ancient silver of Greece and Rome, particularly the former, was rather impure. Very few silver coins of the eight Roman emperors who reigned between the years 270 and 284, are now extant. The *denarii æræi*, or "coins of brass washed with silver," were quite distinct from the silver currency. There were, however, occasional depravations of silver, as appears from the statement of Pliny, that Mark Antony mixed iron with his silver denarii. Of the ancient brass coins, there were two sorts, the red or Cyprian, which must have been copper, and the common yellow brass. Brass, in the Roman coinage, was of double the value of copper, as Mr Pinkerton informs us; and it was probably the same with the Greeks, in whose coinage copper is the metal in most general use. The *sestertii* of the Romans consist of brass; but the middling sized kind, called the *ases*, are made of copper and brass. Electrum, which was the most valuable of the mixed metals, was employed for the most of the early coinage of Lydia and other Asiatic states, and, during the imperial ages, for that of the kings of the Cimmerian Bosphorus. Corinthian brass was next in estimation to the electrum; but that coins were struck of this metal is a mistaken notion, as it was applied solely to the fabrication of vases and toys. Mr Pinkerton, on the authority of Pliny, considers that the coins mistaken for Corinthian brass were of prince's metal.

*Ancient money.*—It is the opinion of Mr Pinkerton that the invention of money, like the other arts and sciences, proceeded from the east into the western parts of the world. As money appeared, at first, without any proper form or impression, the value of the pieces of gold, silver, and even copper, was estimated by weight. Large sums were, in Greece, decided by *mnæ* or *minæ*, and the most capital sums by talents. The mina is supposed to have consisted of 100 drachmæ, or small coins of silver, and 60 minae belonged to the talent. Herodotus affirms that coinage originated with the Lydians, to whom the Greeks were indebted for the invention; and the former, it is supposed, derived their ideas of coinage from the Syrians, who, at a very early period, were remarkable for commercial intercourse. Greek coins of silver, of the greatest antiquity, are without letters, but have an indented mark on one side, and a tortoise on the other. Later ones being marked ΑΙΓΙ have been interpreted of Ægium in Achaia; but as that place was an obscure village, the contraction appears applicable to Ægialus, the ancient name of Sicyon, or rather to Ægina, a city much famed for its mint, which was supposed the most ancient one in Greece.

In estimating the Greek and Roman coins, the medals may be considered as money. Greek coins were sometimes named according to their weight, though the weights were, in some instances, denominated after the coins. The drachma, or eighth part of an ounce, was a general denomination of Greek money. A silver drachma was worth ninepence sterling; but the denarius was only worth eightpence. The value of the didrachm was eighteenpence, and that of the tetradrachm, which was the largest Grecian coin, was five shillings by the Æginean standard. The silver drachma is thus subdivided: a tetraobolion, or coin of four oboli, and weighing 44 grains, worth about sixpence; a hemidrachm, or triobolion of 33 grains, equal to fourpence halfpenny; a silver diobolion, or third of the drachma, weighing 22 grains, and worth threepence; an obolus of silver, of half the weight and value of the diobolion; a hemiobolion, or half obolus, and a tetraobolion dichalcos, or quarter obolus, which latter is the smallest known, though it is said there was a coin still more minute, whose value was three-fourths of a farthing. Copper coins are next in antiquity to the silver, and those of Gelo of Syracuse, introduced about 490 B. C. were the first. The chalcos of brass was proverbial from its insignificance; it being in value merely an eighth-part of a silver obolus. This, however, which was perhaps the first kind of Greek coin, is said to have been afterwards subdivided, though its indivisibility seems sufficiently obvious. Subsequently to the conquest of Greece by the Romans, the coinage was confined to copper, and regulated according to the Roman standard, but some of the Greek terms were retained. This declension in the coinage of the Greeks is thought to have occurred from the time of Augustus down to Gallienus. Before this, however, the coinage of gold had been conducted in Sicily, as gold coins are extant of Gelo about 491 B. C. of Hiero I. 478, and of Dionysius in 404, all having the Greek characters, though not ranked among the gold coinage of Greece as those of Phili were. Gold coins of Syracuse, with an indented square, and a small figure on one of the segments, appear of the third class of antiquity. In the cities of Brettium, Tarentum, and throughout Magna Grecia, as well as in Panticapæa and Cosa in Thrace, gold coins were prevalent. The coining of gold was probably suggested to the Thebans and Athenians by the example of Philip, and the gold of the Ætolians was perhaps coined about a century after the time of Philip. When this monarch obtained the mines of Philippi in Thrace, the annual produce of which is said to have exceeded a thousand talents of gold, or L.2,880,000 of our money, the gold coins bearing his portrait, and called *Philippi* in reference to him, were struck in great abundance. The gold *Philippus* or *stater*, which is a didrachm, and the commonest of the ancient coins, is supposed to have been at first equivalent to 20 silver drachms, and latterly to have been worth 25 Greek drachmæ or Roman denarii. Its value anciently was about 15 shillings, but, according to the present medium rate of L.4 per ounce of gold, it is nearly worth L.1. Besides this, there were current a gold coin of the value of ten silver drachmæ, another worth about five shillings, as well as lesser divisions not worth more than two drachmæ. Gold coins are likewise extant of Alexander and Lysimachus, which are of double the value of the *Philippus* or *stater*, and some by Lysimachus, Antiochus III. and the Egyptian kings, nearly of the value of L.4 Sterling.

In Rome, silver was long unknown, and the *libra gravis æris*, or pound of heavy brass, was at first the medium of calculating money. The pound consisted, as it still does, of 12 ounces of 458 grains each, but that by which money was valued consisted only of 5040 grains in all; and when silver came to be coined, seven denarii went to the ounce of 420 grains. Besides the larger weights, the *scriptulum* or *scrupulum* being the third part of a denarius, was employed in estimating gold. The sestertius, which came to be the grand estimate of Roman money, was equal to two ases and a half, as the name implies, but the *as* was originally the largest and only coin among the Romans. When they afterwards discontinued the denary mode of valuing their money, and allowed 16 ases to the denarius, the sestertius still signified one-fourth of the denarius. To all sums not exceeding 1000 sestertii or L.8, 6s. 8d. was applied the term sestertius, but for greater sums the mode of the sestertius was altered. The Romans being at first unacquainted with the talent, calculated very considerable sums by the hundred weight of brass, and the term *pondus* becoming expressive of the hundred weight, the phrase *sestertium pondus*, denoted two hundred weight and a half. According to Mr Pinkerton, the *as libralis* is worth about eightpence Sterling; so that, estimating the *as* at a pound weight, the value of the *sestertium pondus*, was 1000 sestertii, or L.8, 6s. 8d.; and it is remarkable, that whenever silver coinage became current, the sum of L.8, 6s. 8d. was also uniformly the equivalent of the *sestertium centum denariorum*. Previous to the coinage of silver, however, the purposes of state were sufficiently answered by means of the *pondera gravis æris*, and it would seem that the term *sestertium* was not then in use among the Romans; yet the pondus or hundred weight of brass was exactly equal to 100 denarii, or one pound of silver. Authors never speak of one sestertium, but of a plural number, because the great sestertium was composed of a thousand of the smaller.

The coinage of the Romans was most probably derived from the Etruscans, as they were a colony from Lydia, where, as has been mentioned, the invention is said to have originated. The most ancient Roman coins were cast in moulds, and some are possessed by medallists of the weight of 34 and even 53 Roman ounces. Servius Tullius, who is supposed to have reigned B. C. 460, appears to have coined no other money but the *as*, with the impression of Janus on one side and the prow of a vessel on the other, in allusion to Janus having come to Italy by sea; but, according to Varro, his first coins, in imitation of the Etruscan, bore upon them the figure of a bull or other cattle. Four of these coins, all united together, as originally taken from the mould, are contained in the British museum. There were various subdivisions of the *as*; thus the *semis* or half the *triens* or third, weighing originally four ounces, and therefore marked with four cyphers; the *quadrans* or quarter; the *sextans* or sixth; and the *uncia* or twelfth part, marked with one cypher. The reduction in weight of the *as* occurred as follows: it weighed ten ounces about 300 B. C.; eight about 290; six about 280; four about 270; three about 260; two about 250; one about 214; and about 175 B. C. it was by the Papyrian law reduced to half an ounce, at which it continued long after the time of Pliny. In course of time the parts of the *as* were ornamented with different figures, but on the *as* itself none of these figures appeared until long after. Double *ases* or *dupondii* were introduced about the close of the republic as well as the *sestertii ærei*, which was substituted for the *quadrusses*, when 16 *ases* came to be counted to the denarius. Coins on the Greek scale are found marked as Roman, from the circumstance of the Romans having occasionally adapted their coins to the countries in which their armies were stationed. The types likewise began to vary towards the latter end of the republican times, as appears from a brass coin supposed to be struck by Sextus Pompeius in Sicily, which has upon it a double head of that hero representing a Janus. The sestertius, worth about twopence Sterling, was the largest of the imperial copper coins. In the time of Alexander Severus, this was reduced by one-third of its weight; from the time of Trebonianus Gallus, to that of Gallienus, when the first brass ceases, it weighed not more than one-third of an ounce. The larger coin named double sestertii disappeared after the time of Gallienus; but in the time of Valerian and Gallienus a new coinage, denominated *denarii aeris*, or *Philippi aerei*, seems to have been introduced. In Caracalla's time, the denarii were of two sizes; the larger of six sestertii, or twenty-four assaria, and the smaller of four sestertii, or sixteen assaria. The latter fell afterwards into disuse, but the former, though it was diminished in size, retained its value. From the circumstance of the *Philippus aereus*, which superseded the sestertius, being likewise named denarius, its value seems to have been ten assaria.

Constantine I. about the latter part of his reign, effected the introduction of a new coinage. The *follis,* coined by him, weighed a half ounce, and the *milliarensis*, or larger silver coin, was of the value of 24 follis. The term follis also denoted a purse consisting of 250 milliarensis, as is observable in the Byzantine history. The value of the dupondius was merely half that of the sestertius, and the imperial *as*, or *assarium,* was equal to a halfpenny. It was of copper, and weighed one half ounce; but in the time of Gallienus it was formed of brass, and weighed but an eighth of an ounce, and it continued progressively to diminish to the twentieth part of an ounce. Considering the trifling value of the parts of the *as*, their rare occurrence is not to be wondered at. Small brass coins were very general in the time of Gallienus, and these, as well as the large kind, were marked S. C. and plated with silver. There were likewise small pieces struck for the slaves in the time of the Saturnalia, and marked S. C. meaning, perhaps, *Saturni Consulto.* From the time of Pertinax to that of Gallienus, the diminution of the sestertius was very considerable, though some small pieces coined by Trajanus Decius were current as the semis of the time. Of the brass coins under Gallienus, which were of the size of the denarius, and named *assaria,* 60 went to the silver denarius. One of the smallest coins of antiquity was the *assarion* or *lepton* of the Byzantine empire, weighing only 20 grains, while the *noumia,* of half that weight, is the smallest known in modern times. The follis was the principal coin of the lower or Constantinopolitan empire. It was divided into a half and a quarter, which are supposed to be of brass. In Rome, silver was coined only as late as the 485th year of the city; and those denarii impressed with the word ROMA, are supposed to have been the first. The *denarius* at Rome was equal to eightpence, the *quinarius* was worth fourpence, and the *sestertius* of silver or brass twopence. For 600 years the denarius was the principal silver coin of Rome, and it is from it that the English penny was derived. It may be remarked, that though the Greek ounce consisted of 528 grains, this superiority in weight to the Roman had so little effect on the currency, that Roman coins were as acceptable in Greece as Greek coins were in Rome. According to Pliny, the Roman gold coinage was introduced 62 years after that of the silver, and the scruple went for 60 sesterces. Forty pieces were afterwards coined out of the pound of gold, until, by degrees, the weight was reduced to 45 in the pound. At first, the Roman gold coins, called *aurei,* were in the proportion of 48 in the pound, but, by an augmentation in the weight of each coin, the number was afterwards reduced to 40. The aereus of Sylla was in the proportion of only 30 in the pound, and, consequently, weighed from 164 to 168 grains, but it subsequently fell to the rate of 40 in the pound, when it passed for 20 silver denarii, though at a former period it had continued of the value of 30 silver denarii, or one pound sterling. This coin, during the reign of Claudius, was worth 100 sestertii or 25 silver denarii, and it retained that value until the time of Heliogabalus, when it was reduced to 55 in the pound. It was of the weight of 70 or 80 grains when the *solidus* was substituted in its stead by Constantine I. which coin went for 14 milliarenses and 25 denarii as formerly, and so continued until the decline of the Byzantine empire. Gold coins called *Bezants* in Europe, in allusion to their coming from Byzantium or Constantinople, were *solidi* in proportion of six to the ounce.

*Preservation of Medals.*—Genuine medals, of whatever kind, are prized by collectors according to the degree of preservation in which they are found. Though they should be somewhat impaired, it is essential to the Greek and Roman, as well as the colonial coins, that the legends be tolerably distinct for reading; and even the most common coins, when good and perfect, are appreciated. Brass and copper coins, by lying in certain soils, contract a fine rust; but this, instead of injuring them, is found to be a good preservative, and even ornament. Different kinds of rust, especially green and red, are contracted by silver; but gold is only susceptible of rust from iron. The former is cleansed by means of vinegar, or by boiling in water with three parts of tartar and one of salt; and the latter by steeping in aquafortis, which does not affect gold as a solvent, though it does other metals. Considerable caution, however, is necessary in cleansing silver and gold coins; for the rust being always in spots, there moval of these spots often occasions holes. Any particular blemish or defect in coins and medals (small splits in the edges excepted,) lessens their value. But what are called countermarked medals are much esteemed by scientific judges, as they are supposed to imply an alteration in the value of the coin, as is the case with the countermarked coins of Henry VIII. and of Queen Mary of Scotland. These are distinguished by the impression of a stamp, head, or certain letters, as AUG : N. PROBUS, &c. One cause of the preservation of silver coins is the considerable proportion of alloy which they contain, and this the ancients were evidently aware of. In consequence, likewise, of the ancient practice of burying coins with the dead, to secure for them a passage over the river Styx, great numbers of coins have been from time to time obtained in a perfect state. "From Phidon of Argos," says Mr Hancarville, "to Constantine I. are 36 generations, and from Magna Graecia to the Euphrates, from Cyrene to the Euxine sea, Grecian arts prevailed; and the inhabitants amounted to 30,000,000. There died, therefore, in that time and reign, not less than ten thousand millions of people, all of whom had coins of one sort or other buried with them. The tombs were sacred and untouched, and afterwards neglected, till modern curiosity or chance began to disclose them." When we therefore consider the vast quantities of coins and medals thus disposed of, it seems matter of no small surprise that more of them have not been discovered. From the best authorities, Mr Pinkerton estimates that the different ancient coins, known in modern times, do not exceed 80,000.

*True and Counterfeit Medals.*—The forgery of medals almost commenced with the science of Numis-

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matography itself, and many have been so ingeniously executed as even to deceive the learned. It is thus a difficult, as well as an important matter, to distinguish real from counterfeit medals, especially as the most celebrated artists have engaged in the trade of forging them. Among the most eminent artists who have succeeded in counterfeiting medals are Victor Gambello, Giovanni del Cavino and his son, Benvenuto Cellini, Alexandro Greco, Carteron of Holland, and others in the 16th century; but the forgeries of Cavino and Carteron are most numerous and striking. The forgeries of Greek medals that have appeared are of little or no moment, and indeed the true coins themselves were comparatively little known before the works of Hubertzus Goltzius, which were published after the era of the grand forgeries. But the Roman medals have been the prime object of forgery, not only among modern artists, but also in the time of the Romans themselves, when some counterfeits, it is said, were executed in such a masterly style as to be even more esteemed than the genuine coins. No historic faith is to be put in plated coins. Of the consular coins the only remarkable counterfeit is that of the silver denarius of Brutus. Modern medallic forgeries embrace chiefly the imperial series of medals; and counterfeits are, by Mr Pinkerton, discriminated in six divisions. These are as follows: 1. Such as are known to be imitations, but valued on account of the artists by whom they are executed, and among these the Paduan rank highest. 2. Those cast from moulds taken from the Paduan forgeries, and others done by eminent masters. 3. Medals cast in moulds from an antique. 4. Ancient medals retouched and altered, which class is particularly difficult to discern. 5. Medals impressed with new devices, or soldered; which class is easily discovered, the inscriptions and devices being known to exist in genuine medals. 6. Plated medals, and those which have artificial clefts in imitation of natural ones, which, as has been already hinted, do not by any means lessen the value of a coin or medal. After detailing these classifications of counterfeits, our author very judiciously remarks, that "a real and practical knowledge of coins is only to be acquired by seeing a great number, and comparing the forged with the genuine. It cannot therefore be too much recommended to the young connoisseur, who wishes to acquire some knowledge in this way, to visit all the sales and cabinets he can, and to look upon all ancient medals with a microcopic eye." "Forgeries of modern coins and medals," Mr Pinkerton farther observes, "are almost as numerous as of the ancient; the most remarkable instance of which is the counterfeit of the satiric coin of Louis XVII. PERDAM BABYLONIS NOMEN,—together with the coins of the early princes of England.

*Comparative Value of Medals.*—Independent of other considerations, the rarity of a medal constitutes its intrinsic value. Of the different degrees of rarity, the highest is denominated *unique*. The discovery of hoards of coins must evidently render common what were otherwise scarce and most highly appreciated, as was the case with the farthings of Queen Anne, some of which, it is said, brought the sum of five guineas each, previous to a quantity being found in the Orkneys. Most of the Greek civic coins of silver are of rare occurrence; didrachms likewise are scarce; and, in particular, the silver tetradrachm is among the most scarce and high priced of coins. A coin of Mithridates was sold in 1777 for the sum of L.26, 5s. One of the most rare of the smaller Greek coins is the silver didrachm of Alexander the Great. Greek copper coins are in general scarce, though those of Hiero I. of Syracuse, and of several of the Ptolemies, are not unfrequent. Of the Roman coins, those restored by Trajan, together with the gold consular coins, are the most seldom met with; while the silver, if we except the coin of Brutus, already noticed, are more general. Roman imperial coins are rare. The brass coins of Otho, with Latin inscriptions, and figures on the reverse, are generally doubtful. Leaden coins of Rome are said to be uncommon, as well as genuine coins, which appear to have been accidentally blundered in the mint. English heptarctic coins are seldom found, excepting the *stycas*, and those of Burgred king of Mercia, which are plentiful. Coins of Alfred and of Hardyknute are unusual, and of King John and Richard I. no English coins are extant. The coins of Alexander II. are rare, as well as those of John Baliol; and of Edward Baliol none is to be met with.

Of Medals.

*Arrangement of Medals.*—By a proper arrangement of his cabinet, the medallist is enabled to reap satisfactory instruction and entertainment from his collection. In respect of antiquity, the first series of ancient medals must commence with those of Alexander the Great of Macedon; then must follow those of Sicily, Caria, Cyprus, Heraclia, and Pontus, to which again succeed those of Egypt, Syria, the Cimmerian Bosphorus, Thrace, Bithynia, Parthia, Armenia, Damascus, Cappadocia, Paphlagonia, Pergamus, Galatia, Cilicia, Sparta, Pæonia, Epirus, Illyricum, Gaul, and the Alps, embracing the period from Alexander the Great to the birth of Christ, and which is to be considered the third series. In the last series, which descends to the fourth century, are included several of the kings of Thrace, Bosphorus, and Parthia, in conjunction with those of Comagene, Edessa, or Osrhoene, Mauritania, and Judæa. A correct series is formed of the Roman emperors, from Julius Cæsar to the destruction of Rome by the Goths; and of modern monarchs different series may be formed. On the Greek coins the only decoration of the portraits is a diadem, as an emblem of sovereignty; but in preference to the diadem the Romans adopted the radiated crown, or emblem of deification, which appeared first on the posthumous coins of Augustus, and after the lapse of a century became common. Beginning with Julius Cæsar, all the emperors appear with the radiated crown, which is also occasionally worn by Greek princes. The naval, mural, and civic crowns, were likewise allowed to great men as well as to the emperors. Medals of Alexander and his successors appear symbolical of the assumption of divine honours by these princes. Sometimes, also, the helmet appears on coins. The bust is commonly seen on medals, and when half the body or more is given, the hands appear with particular emblems. A variety of portraits are discovered on medals, and these are recommended to be arranged under the cities or monarchs whose names they bear. Great ingenuity is displayed in the reverses of medals, both Greek and Roman; the former evincing superior workmanship, and the latter more art and design. No reverses appear on very ancient coins, but merely a rude mark received in the striking of an impression on one side; but most exquisite reverses adorn the Greek coins about 500 B. C. Reverses contain figures of deities with appropriate symbols, as well as public symbols,—diversions, animals, plants, and various other objects of nature and art; likewise the portraits appearing on some of them are of consequence to the antiquary. In Greek coins the names of the divinities represented are not given, but in the coins of the Romans the name is always expressed, and that sometimes with the addition of the name of the emperor or empress, as PUDICITIÆ AUGUSTÆ round an image of Modesty; VIRTUS AUGUSTI, a legend for an image of Virtue. Legends on medals are obviously designed as explanatory, but those of the Greeks are more readily deciphered than those of the Romans, because the words are less abreviated. Roman imperial coins are admired for the simplicity of the legends, of which IVDEA CAPTA and ASIA SUBACTA are good examples. Of the mistakes that are apt to occur in the deciphering of legends, the following instance, adduced by Mr Pinkerton, is not a little amusing: Fortunius Licetus, a learned man, finding upon a coin of Adrian the letters T. IΔ, signifying the fourteenth year of that emperor's reign, imagined that they signified *Lucernas invenit Delta*, "Delta invented lanthorns;" and thence he ascribed the origin of lanthorns to the Egyptians. Mr Pinkerton and others have given tables in explanation of the abbreviations on medals.

*Of Cabinets.*—There are three kinds of cabinets. The first is that which contains specimens of all the coins of every age and country; and of this description is Dr William Hunter's, the original cost of which was L.23,000, and that of the king of France the expense of which exceeded L100,000. Small cabinets, containing, besides a few of the more valuable coins and medals, a due collection of Roman brass, English pennies, groats, &c. may be procured at the cost of from L.200 to L.1000; and as to a casket of medals, the expense attending it depends upon the pleasure of the collector. The following is Mr Pinkerton's method of arranging a grand cabinet: I. The coins of cities and of free states, in alphabetical order, whether using Greek, Roman, Punic, Etruscan, or Spanish characters. II. Kings, in chronological series, both as to foundation of empire and seniority of reign. III. Heroes, heroines, founders of empires and cities. IV. Other illustrious persons. V. Roman ases. VI. Coins of families commonly called consular. VII. Imperial medallions. VIII. Imperial gold. IX. Imperial minimi of all metals. X. Imperial silver. XI. Imperial first brass. XII. Second brass. XIII. Third brass. XIV. Colonial coins which are all of brass. XV. Greek cities under the emperors, of all metals and sizes. XVI. Egyptian coins struck under the Roman emperors, of all metals and sizes. XVII. Contorniati, or ticket medals. XVIII. Coins of Gothic princes, &c. inscribed with Roman characters. XIX. Coins of southern nations using uncommon alphabets, as the Persian, Punic, Etruscan, and Spanish. XX. Coins of northern nations using uncommon characters, as the Runic and German. In the modern part no series can be formed of copper that will go back about two centuries, but sequences (chronological series) of gold and silver may be arranged of all the different empires, kingdoms, and states, as far as their several coinages will allow. Those of England and France will be the most perfect. Modern silver is commonly arranged in three sequences, the dollar, the groat, and the penny sizes. The medals of each modern country ought of course to be separated, though it is best to arrange each set in chronological order, let their size of metal be what it may. The following marks are set down by Froelich as absolute evidences of the great antiquity of coins: 1. Oval circumference, and globulous swelling shape. 2. Antiquity of alphabet. 3. Characters retrograde, or the first division of the legend in the common style, while the next is retrograde. 4. The indented square. 5. Simple structure of the mintage. 6. Their being hollowed on the reverse, with the image impressed on the front. 7. The dress, symbols, &c. of rude design and execution.

*Symbols on Ancient Coins and Medals*—Among the most remarkable symbols on the Greek medals are the following:

1. Jupiter is distinguished by his eagle and thunderbolts, or, when the figure appears on the obverse alone, by a placid bearded countenance and a laurel crown. Jupiter Ammon has the ram's horn twisted round his ear, as an emblem of power and strength; which symbol was assumed by Alexander the Great and his successors. 2. Neptune is drawn by sea-horses, or is known by his trident or dolphin. 3. Apollo is known by the harp, branch of laurel, or tripod, or by a bow and arrows. His head, in allusion to the sun, is adorned with rays. 4. Mars has his head armed with a helmet, and presents a wild countenance, and is also distinguished by his armour, or by a trophy on his shoulders. 5. Mercury is known by his cap and wings, together with the caducus, or wand twined with serpents, and the marsupium, or purse, which he holds in his hand. 6. Æsculapius is distinguished by his bushy beard, and by his leaning on a club entwined with a serpent, and occurs occasionally with Hygeia his wife, and *Telesphorus*, or Convalescence. 7. Bacchus appears with his crown of ivy or vine, his diadem and horn, with a tiger and satyrs about him. 8. Hercules is distinguished by his apparent strength, lion's skin, and club; likewise he has often a cup in his hand, together with the appendage of a poplar-tree, as a symbol of health. On the coins of Alexander the Great, this figure has been mistaken for that of Alexander himself. 9. The Egyptian Serapis has a bushy beard, and a measure upon his head. 10. Apis is designed under the form of a bull, with a flower of the lotos, the water-lily of the Nile, which is thought emblematical of creation. 11. Harpocrates, the god of silence, is observed to have his finger on his mouth, and sometimes the sistrum in

Of Symbols.

his left hand. 12. Canopus, another Egyptian deity, appears in the shape of a human head placed on a kind of pitcher. 13. The Holy Senate and Holy people appear as old men with beards, or as youths.

Goddesses likewise are represented on medals.

1. Juno appears as a beautiful young woman with a diadem, and sometimes without any badge. As the goddess of marriage, she is veiled to the middle, and she is moreover distinguished by the peacock, which is a bird sacred to her. 2. Minerva has for her symbols a spear in her right hand, and the ægis with a Medusa's head in her left, and an owl commonly stands by her. 3. Diana of Ephesus is represented with a number of breasts, allusive, perhaps, of universal nature. Supported by two deers, she carries a pannier of fruit upon her head. On her brow is a crescent, and at her side the bow and quiver. 4. Venus holds in her hand an apple, as the prize of beauty, and sometimes she is adorned with pearls about her neck. 5. On the Syrian coins, Cupid is characterized by his infancy and wings. 6. Cybele is represented with a turreted crown and lion, or drawn in a chariot by lions. 7. Ceres is distinguished by her garland of wheat. She sometimes has two serpents by her, or is drawn in a chariot by them. In her hand she carries torches, as if in search of Proserpine her daughter. 8. Proserpine, also is represented on coins. 9. The Egyptian Isis is distinguished by a bud or flower on her head, as well as by carrying a sistrum in her hand. 10. The Sidonian Astarte is represented on a globe supported on a chariot, and drawn by two horses.

The following deities are less commonly represented on medals: Saturn, with his scythe, or with a hook on the Heraclean coins; Vulcan, with his tongs, on the reverse of a coin of Thyatira, represented at work in the presence of Minerva. Adranus, a Sicilian god, is represented with a dog. Anubis, an Egyptian deity, has a dog's head; Atis is distinguished by the Phrygian bonnet; Castor and Pollux by a star on the head of each; Pluto by his aged face, dishevelled hair and beard, and a hook; Flora by a crown of flowers; Nemesis by her wheel; and Pan by his horns and ears of a beast.

The following is a list of symbols, with their significations, which are met with by themselves on medals: 1. Vases with sprigs denote solemn games; 2. Small chest or hamper with a serpent leaping out, Mystic rites of Bacchus; 3. Anchor, on Seleucian medals, coin struck at Antioch, where an anchor was dug up; 4. Apollo on Syrian coins, on an inverted hamper, covered tripod; 5. A bee, Aristeus the son of Apollo; 6. Laurel, Apollo; 7. Reed, a river; 8. Ivy and grapes, Bacchus; 9. Poppy, Ceres and Proserpine; 10. Corn, Ceres; 11. Owl and olive, Minerva; 13. Dove, Venus; 14. Torch, Diana, Ceres, or Proserpine; 14. Mudnis, or conic stone, the Sun, Belus, or Venus; 15. Pomegranate flowers, Rhodes; 16. Owl, Athens; 17. Pegasus, Corinth; 18. Wolf's-head, Argos; 19. Bull's head, Bœotia; 20. Minotaur's head and labyrinth, Crete; 21. Horses head, Pharsalia; 22. Lion, Marseilles; 23. Tortoise, Peloponnesus; 24. Sphinx, Scio; 25. Three legs joined, Sicily; 26. Horse, Thessaly: 27. Crescent, Byzantium; 28. Bull, supposed a river; 29. Ensign with the letters Col, a colony drawn from one legion; 30 Bull, Apis, strength or security; 31. Caduceus, Peace and Concord; 32. Cornucopia, Abundance; 33. Pontifical hat, Priesthood; 34. Parazonium, Baton of command; 35. Globe on an altar with three stars, The world preserved by the gods for the three sons of Constantine I.; 36. Fort and gate, Security; 37. Tribuli, a kind of chevaux de frize, unknown; 38. Altar or tripod, Piety; 39. Dolphin, Apollo; 40. Lectisternia, Festivals; 41. Lituus, or twisted wand, Augurship. 42. Apex, or cap with strings, Pontificate; 43. Thensa, or chariot employed to carry images, Consecration of an empress; 43. Peacock, ditto; 45. Eagle, Consecration of an emperor.

Of Abbreviations.

## Abbreviations used in the Legends of Coins and Medals: from Mr. Pinkerton.

### *Greek Coins.*

Α. Athens, Argos, Aulus, Asylum, primi or first; as Εφεσιων Α. Ασιας, "Ephesians, first people of Asia." Α. Abassus, Abdera, Abydus on the Helle pont. Α. Β. Abydus in Egypt. ΑΒΥ. Abydus on the Hellespont. ΑΘ. ΑΘΕ. Athens. ΑΙΓ. Aegina. ΑΙΓΟΣΠΟ. Aegospotamos. ΑΙΛ. Aelius, Aelia Captiolina. ΑΙΝ. Aenos. ΑΚ. ΑΚΡΑΓΑΝ. Agrigentum. ΑΚΙ. Acilium. ΑΚΤ. Actium. ΑΛΕ. Alexandria. ΑΜ. Amyntas. ΑΜΒΡ. Ambracia. ΑΜΦΙ. Amphilochia. ΑΝΘ. Ανθυπατος, Proconsul ΑΝΤΙΣ. Antissa. ΑΝΑ. Anactoria. ΑΝΤΙ. Antium. ΑΝ. Ancyra. ΑΝΤ. Antoninus, Antioch. ΑΞ. Axus in Crete. ΑΟΝ. Aonitæ. ΑΟΥΕ. Avenio, *Pell.* ΑΠ. Appius. ΑΠΑ. Apamea. ΑΠΟ. Apollonia. ΑΠΤΑ. Aptara. ΑΡ. Aradus, Harma. ΑΡΓΕ. Argennos. ΑΡΓ. Argos. ΑΡΙ. Aricanda. ΑΡΙΜ. Ariminum. ΑΡΣΙ. Arsinoë. ΑΡΥ. Aryca. ΑΡΧ. Αρχιερευ, or Αρχον, High-priest or Magistrate. ΑΣΙΑΡΧ. Asiarchæ, Presidents of the games of Asia. ΑΣ. Asylum. Α. Σ. Πρωτοι Συριας, First of Syria. ΑΣΚ. Ascalon. ΑΤ. Atabyrium. ΑΤΑΡ. Atarnæ. ΑΥΓ. Augustus. ΑΥΡΗΛ. Aurelius. ΑΥ. ΑΥΤ. Αυτοκρατωρ, Emperor. ΑΥΤΟΝ. Αυτονομοι, Enjoying their own laws. ΑΦΙ. Aphyta. ΑΦΡ. Africanus. ΑΧ. Ach. ii.

Β. Βουλης, Council; Berytus, Bythinia. ΒΑΓ ΗΔΑΟ. Bagadaonia. ΒΑΛ. Valerius. ΒΗ. Berytus. ΒΙΤΟΝ. Bitontum. ΒΟΙ. Bœotia. ΒΡΥΝ. Brundusium. ΒΥ. Byzantium.

Γ. ΓΡ. ΓΡΑΜ. Grammaticus, or keeper of the records. Γ. Gaius, or Caius. ΓΑ. Gallus, Galerius, Galienus. Γ. Γνωριμος, Illustrious. ΓΕΛ. Gelas. ΓΕΡ. Germanicus. ΓΝ. Genius. ΓΟΡΤΥ. Gortyna. ΓΡΑ. Gravisca.

Δ. Decimus, Dymæ. ΔΑΚ. Dacicus. ΔΑΜ. Damascus. ΔΑΡ. Dardanum. ΔΗ. Δημος, The people. ΔΗΜΑΡΧ. ΕΞΟΥΣ. with Tribunitian power. ΔΕ. Decelia. ΔΕΚ. Decius. ΔΕΡ. Derbe in Lycaonia. ΔΗ. Delos. ΔΙ. Diospolis. ΔΡΕ. Drepanum. ΔΥΡ. Dyrrhachium.

Ε. Eryce. Ε. ΕΡΕΣ. Eresus. ΕΛΕΥ. Eleusius. ΕΛΕΥΘ. Ελευθεροι, Free. ΕΠΙ. Epidaurus. ΕΡΙ. Eriza in Caria. ΕΡΧ. Erchia. ΕΡΥ. Erythræ. ΕΤ. ΕΤΟ. Ετους, Year. ΕΤ. Etenna in Pamphylia. ΕΞ.

Of Abbreviations.

Εξουσια, Power. ΕΥ. ΕΥΒΟ. Eubœa. ΕΥΣ. Ευσεϐης, Pious. ΕΥΤ. Ευτυχης, Happy. ΕΦ. ΕΦΕ. Ephesus.

ΖΑ. Zacynthus. ΖΑΓΚΛ. Zancle, Messana anciently so called.

Η. Elium. ΗΓ. Ηγεμων, President. ΗΡΑΚ. Heraclea.

ΘΑ. Thasus. ΘΕ. Thespiæ. ΘΕΣ. Thessalonica. ΘΗ. ΘΗΒ. Thebæ.

Ι. ΙΕΡ. Ιερος, Sacred. ΙΕΡΑΠΥ. Hierapytha. ΙΚΑΡ. Hiccara. ΙΛΙ. Ilium. ΙΟΥ. Iulius a city, or Julius. ΙΟΥΛ. Julia. ΙΠΑ. Hippana. ΙΡ. Irene. Ins. *Pellerin.* ΙΣ. Isus, Istiæa.

Κ. Caius; Κουιντος, Quintus. Κ. ΚΑΙΣ. Cæsar. Κ. Κ. Κοινον Κιλικιας, Community of Cilicia. ΚΑΙΛ. Cælius. ΚΑΛ. Chalcedon. ΚΑΛΛΙ. Callipolis. ΚΑΜΑ. Camara. ΚΑΝ. Canata. ΚΑΠ. Capua. ΚΑΠΠ. Cappadocia. ΚΑΡ. Carrhæ. ΚΑΡΤ. Carthago. ΚΑΥ. Caulonia. ΚΕ. Ceos. ΚΕΦ. Cephalædis. ΚΙ. Cianus, Cibæum. ΚΙΛ. Cilbiani. ΚΛ. Clæunæ, Claudius. ΚΛΑ. Clazomene. ΚΝΙ. Cnidos. ΚΟ. Corinth. ΚΟΙΝ. Κοινον, Community. ΚΟΛ. Κολονια, Colony; Colophon. ΚΟΜ. Commodus. ΚΟΡ. Corcyra. ΚΡ. Cragus in Lycia. ΚΡΑ. Cranos. ΚΡΗ. Crete. ΚΤΗ. Ctemene, *Pell.* ΚΥ. Cuma, Cydonium, Cyon. ΚΥΘ. Cythnus. ΚΥΠ. Cyprus. ΚΥΡ. Cyrene.

Λ, or L. Λυκαϐας, Year. Λ. Lucius. ΛΑ. Lacedæmon. ΛΑΜ. Lamea, Lampsacus. ΛΑΡ. Larissa. ΛΑΡΙ. Larinum. ΛΕ. ΛΕΥ. Leucas. ΛΕΟΝ. Leontium. ΛΗΜ. Lemnos. ΛΙΠ. Lipara. ΛΙΥΙ. Liviopolis. ΛΟ. ΛΩΚ. Locri. ΛΟΓ. Longone. ΛΥΓ. ΛΥΚ. Lyctus.

Μ. Marcus, Malea, Megalopolis, Mazaka. ΜΑ. Maronea, Massilia, Macedonia. ΜΑΓ. Magnesia. ΜΑΚΡΟ. Macrocephali. ΜΑΜ. Mamertini. ΜΑΣΣ. Massilia. ΜΑΖ. Mazara. ΜΕ. Menelais, on Syrian regal coins. ΜΕΝΕΚ. Menecrates. ΜΕ. ΜΕΓ. Melite, Megara, Megalopolis. ΜΕΓ. Μεγαλος, Great. ΜΕΣ. Messana. ΜΕΤΑ. Metapontum. Μ. ΜΗΤΡΟ. Metropolis. ΜΙ. Miletus. ΜΚ. Mazaka of Cappadocia, on coins of Mithridates VI. ΜΟΡ. Morgantia. ΜΥ. Mycenæ. ΜΥΡ. Myrloa. ΜΥΤΙ. Mytilene.

Ν. Naupactos. ΝΑΞ. Naxos. ΝΑΥΑΡΧ. Ναυαρχιδοι. Enjoying a sea-port. ΝΕ. Nemea. Ν. ΝΕΩΚ. Neocori. ΝΕΟΠ. Neopolis. ΝΕΡ. Nerva. ΝΙΚ. Nicæum, Nicomedia. ΝΥΣ. Nysæi, on coins of Scythopolis, *Pell.*

ΟΙ. Oethæi. ΟΝ. Οντος, Being. ΟΠΕΛ. Opelius. ΟΠ. Opus. ΟΡΥ. Orycus. ΟΡΧ. Orchomenus. ΟΥΠ. or ΥΠ. Ουπατος, or Υπατος, Consul. ΟΥΕΡ. Verus. ΟΥΕΣΠ. Vespasianus. ΟΥΕΤ. Vetus. ΟΥΙΤΕΛ. Vitellius. ΟΦΡΥ. Ophrynium.

Π. Παρα, Προς, upon. Π. ΠΟΠΛ. Publius. Π. ΠΑ. Paphos or Paros. ΠΑΙΣ. Pæstum. ΠΑΝ. Panormus. ΠΑΡ. Paropinum. ΠΑΡΙ. Paros. ΠΑΡΘ Parthicus. ΠΕ. Perinthus. ΠΕΛ. Pella. ΠΕΡ. Pergus. ΠΕΡΤ. Pertinax. ΠΕΣΚ. Pescennius. Π. ΠΗ. Pelusium. ΠΙΝ. Pinamytæ. ΠΛΑ. Plateæ. ΠΟ. Pontus. ΠΟΛΥ. Polyrrhenum. ΠΟΣ Posidonia. ΠΡΑΣ. Prassus. Π. ΠΡΥ. Πρυτανις, Præfect. ΠΡ. ΠΡΕΣ. Πρεσϐυς, Legate. ΠΡΟ. Proconnesus. ΠΡΟΔΙ. Προδικος, Curator. Π. ΠΡΩΤ Πρωτος, First. ΠΤ. Ptolemais. ΠΥ. Pylos.

Of Abbreviations.

ΡΟ. Rhodes.

Σ. ΣΑ. Salamis, Samos, Syria. ΣΑ. Samosata ΣΑΛΑΠ. Salapia. ΣΑΡ. Sardis. ΣΕ. Seriphus, Segeste. ΣΕΒ. Σεϐαστος, Augustus. ΣΕΛ. Selinus, Seleucia. ΣΕΠΤ. Septimius. ΣΙ. Siphnos. ΣΙΔ. Side. ΣΙΝΩ. Sinope. ΣΜΥ. Smyrna. ΣΤΡ. ΣΤΡΑ. Στρατηγος, Prætor. ΣΥΒ. Sybaris. ΣΥΡΑ. Syracuse. ΣΩ. Solæ.

Τ. Titus. ΤΑΒΑΛ. Tabala. ΤΑ. ΤΑΝΑ. Tanagra. ΤΑΡ. Tarentum, Tarsus. ΤΑΥΡ. Tauromenum. ΤΕ. Temenits. ΤΕΡ. Terina. ΤΗ. Tenus. ΤΙ. ΤΙΒ. Tiberius. ΤΡΑ. Trallis. ΤΡΙ. Tripolis. ΤΡΟ. Troizene. ΤΥΑΝ. Tyana. ΤΥ. Tyndaris. ΤΥΡ. Tyre (monogram).

ΥΕ. ΥΕΛ. Velia. ΥΠ. ΥΠΑΤ. Υπατος, Consul.

Φ. Philip, Phœstus, Philuntium. ΦΑ. Phaselis. ΦΑΡ. Pharsalus. ΦΙ. Vibius, Philippopolis. ΦΙΝΕ. Phineium. ΦΛ. Flavius. ΦΟΚ. Phocæum. ΦΟΥΛ. Fulvia. ΦΥ. Phycus in Cyrene.

Χ. Chios. ΧΑΛ. Chalcis. ΧΕΡ. Chersonesus. ΧΙ. Chytri in Crete.

*Greek Numerals.*

| | | | | | |
|---|---|---|---|---|---|
| Α. | 1. | Ι. | 10. | Ρ. | 100. |
| Β. | 2. | Κ. | 20. | Σ. or C | 200. |
| Γ. | 3. | Λ. | 30. | Τ. | 300. |
| Δ. | 4. | Μ. | 40. | Υ. | 400. |
| Ε. | 5. | Ν. | 50. | Φ. | 500. |
| ϛ. or ⇄ | 6. | Ξ. | 60. | Χ. | 600. |
| Ζ. | 7. | Ο. | 70. | Ψ. | 700. |
| Η. | 8. | Π. | 80. | Ω. | 800. |
| Θ. | 9. | q, or ϙ | 90. | ϡ. | 900. |

*Examples.* I is 10: add Α to I, and ΙΑ makes 11: so ΙΒ, 12, ΙΓ, 13, &c. Κ is 20, ΚΑ, 21, &c. ΡΙΑ makes 111. The English word AIR marks the grand initial numerals. On coins the numerals are often placed in retrograde order; which makes no difference in the value, as every letter is appropriated to its number. Thus ΤΛΓ or ΓΛΤ imply the same, 333. But this advantage being unknown to the Roman numerals and Arabic ciphers, is apt to puzzle the beginner.

*Roman Coins.*

A. Aulus: in the exergue it implies the first mint, as ANT. A. coined at Antioch in the first mint. A A. A. F. F. Auro, Argento, Ære, Flando, Feriundo. A. or AN. Annus. A. A. Apollo Augusti. A. F. A. N. Auli filius, Auli nepos. ABN. Abnepos. ACT. Actiacus, or Actium. AD FRV. EMVP. Ad fruges emundas, ADIAB. Adiabenicus. ADOP. Adoptatus. ADQ. Adquisita. ADV. Adventus. AED. Ædes. ALD. E. Ædilitia potestate. AED. S. Ædes sacræ. AED. CVR. Ædilis Curulis. AED. PL. Ædilis Plebis. AEL Ælius. AEM. or AIMIL. Æmilius AET. Æternitas. AFR. Africa, or Africanus. ALBIN. Albinus. ALIM. ITAL. Alimenta Italiæ. ANN. AVG. Annona Augusti. A. N. F. F. Annum Novum Faustum Felicem. ANIC. Anicius. ANN. DCCCLXIIII. NAT. VRB. P. CIR. CON. Anno 864. Natali Urbis Populo Circenses constituti. ANT. AVG. Antonius Augur. ANT. Antoninus, or Antonius. AP. Appius. A. P. F. Argento Publico Feriundo. A. POP. FRVG. AC. A Populo Fruges Acceptæ. AQ. AQL. Aquilius. AQVA MAR.

Of Abbreviations.

Aqua Martia. ARAB. ADQ. Arabia Adquisita. ARR. Arrius. AVG. Augur, Augustus, Augusta. AVG. D. F. Augustus Divi Filius. AVGG. Two Augusti. AVGGG. Three Augusti. AVR. or AVREL. Aurelius.

B. The mark of the second mint in any city. BON. EVENT. Bonus Eventus. B. R. P. NAT. Bono Republicæ Nato. BRIT. Britannicus. BRVT. Brutus.

C. Caius, Colonia. C. A. Cæsarea Augusta. C. CAE. or CAES. Cæsar. CAESS. Cæsares. CARTH. Carthage. CEN. Censor. CENS. P. Censor Perpetuus. CEST. Cestius, or Cestianus. CIR. CON. Circum Condidit, or Circenses Concessit. CIVIB. ET SIGN. MILIT. A PARTH. RECVP. Civibus et Signis Militaribus a Parthis Recuperatis. CN. Cneius. COEL. Cœlius. CON. OB. Constantinopoli Obsignata, or Constantinopoli Officina secunda, or Conflata Obryzo. COL. Colonia. CON. SVO. Conservatori suo. CONCORD. Concordia. CL. V. Clypeus Votivus. COMM. Commodus. CLOD. Clodius. CL. or CLAVD. Claudius. COS. Consul. COSS. Consules. CORN. Cornelius. CVR. X. F. Curavit Denarium Faciendum.

D. Decimus, Divus, Designatus. DAC. Dacius. D. F. Dacia felix. D. M. Diis Manibus. DES. or DESIG. Designatus. DICT. Dictator. DOMIT. Domitianus. D. N. Dominus noster. DID. Didius. D. P. Dii Penates. DV. Divus.

EID. MAR. Idus Martiæ. EX CONS. D. Ex Consensu Decurionum. EX S. C. Ex Senatus Consulto. EQ. ORDIN. Equestris Ordinis. EX A. PV. Ex Argento, or Auctoritate Publica. EXER. Exercitus. ETR. Etruscus.

F. Filius, or Filia, or Felix, or Faciendum, or Fecit. FEL. Felix. FELIC. Felicitas. FL. Flavius. FLAM. Flam. FORT. RED. Fortunæ Reduci. FOVRI. Fouricis for Furius. FONT. Fonteius. FRVGIF. Frugiferæ (Cereri.) FVL. Fulvius. FVLG. fulgerator.

G. Gneius, Genius, Gaudium. GA. Gaditanus. G. D. Germanicus Dacicus. GEN. Genius. GERM. Germanicus. GL. E. R. Gloria Exercitus Romani. GL. P. R. Gloria Populi Romani. GOTH. Gothicus. G. P. R. Genio Populi Romani. G. T. A. Genius Tutelaris Ægypti, Africæ.

HEL. Helvius. HEL. Heliopolis. HER. Herennius. or Herennia. HO. Honos. HS. Sestertius.

I. Imperator, Jovi, Julius. IAN. CLV. Janum clusit for clausit. IMP. Imperator. IMPP. Imperatores. I. S. M. R. Juno Sospita, Mater, or Magna Regina. IT. Italia. Iterum. ITE. Iterum. IVL. Julius or Julia. IVST. Justus. I. I. S. Sestertius. I. O. M. SACR. Jovi Optimo, Maximo, Sacrum. II. VIR. Duumvir, III. VIR. R. P. C. Triumvir Reipublicae Constituendae. IIII. VIR. A. P. F. Quatuorvir, or Quatuorviri, Auro, or Argento, or Ære, Publico Feriundo. IVN. Junior.

L. Lucius. LAT. Latinus. LEG. PROPR. Legatus Proprætoris. LEG. I. &c. Legio Prima, &c. LEP. Lepidus. LENT. CVR. X. F. Lentulus Curavit Denarium Faciundum. LIBERO. P. Libero Patri. LIB. PVB. Libertas Publica. LIC. Licinius. L. S. DEN. Lucius Sicinius Dentatus. LVC. Lucifera. LVD. CIR. Ludi Circenses. LVD. EQ. Ludi Equestres. LVD. SAEC. F. Ludos Sæculares Fecit.

Of Abbreviations.

M. Marcus, or Marius. MAR. CL. Marcellus Clodius. M. F. Marci Filius. M. OTAICL. Marcia Otacilia. MAG. or MAGN. Magnus. MAC. Macellum. MAX. Maximus. MAR. Martia (aqua.) MAR. VLT. Marti Ultori. MES. Mesius. METAL. Metallum. MINAT. Minatius. MINER. Minerva. M. M. I. V. Municipes Municipii Julii Uticensis. MON. or MONET. Moneta.

N. Nepos or Noster. N. C. Nobilissimus Cæsar. NAT. VRB. Natalis Urbis. NEP. Nepos. NEP. RED. Neptuno Reduci.

O. Optimo. OB. C. S. Ob Cives Servatos. OF. Officina. OPEL. Opelius. ORB. TER. Orbis Terrarum.

P. or POT. Potestate. PAC. ORB. TER. Pacatori Orbis Terrarum. PAPI. Papius or Papirius. PARTH. Parthicus. PERP. Perpetuus. PERT. or PERTIN. Pertinax. PESC. Pescennius. P. F. Pius Felix. PLÆT. Plætonius. P. L. N. Pecunia Londini Notata. P. LON. S. Pecunia Londini Signata. P. M. or PONT. MAX. Pontifex Maximus. POMP. Pompeius. P. P. Pater Patriæ. P. R. Prætor. P. R. Populus Romanus. PRAEF. CLAS. ET OR. MARIT. Præfectus Classis et Oræ Maritimæ. PRINC. IVVENT. Princeps Juventutis. PRIV. Privernum. PROC. Proconsul. PRON. Pronepos. PROP. Proprætor. PROQ. Proquæstor. PROV. DEOR. Providentia Deorum. PVPIEN. Pupienus.

Q. Quintus, or Quaestor. Q. C. M. P. I. Quintus, Cæcilius Metellus Pius Imperator. Q. DESIG. Quaestor Designatus. Q. P. Quæstor Prætorius. Q. PR. Quæstor Provincialis.

R. Roma, Restitit. RECEP. Receptis, or Receptus. REST. Restitit. ROM. ET AVG. Romæ et Augusto. R. P. Respublica.

SAEC. AVR. Sæculum Aureum. SAEC. FEL. Sæculi Felicitas. SAL. Salus. SAL. Sallustia. SARM. Sarmaticus. S. C. Senatus Consulto. SCIP. ASIA. Scipio Asiaticus. SEC. ORB. Securitas Orbis. SEC. PERP. Securitas Perpetua. SEC. TE. Securitas Temporum. SEN. Senior. SEPT. Septimius. SER. Servius. SEV. Severus. SEX. Sextus. SIC. V. SIC. X. Sicut Quinquennalia, sic Decennalia. SIG. Signis. S. M. Signata Moneta. S. P. Q. R. Senatus Populusque Romanus. STABIL. Stabilitas (terra.) SVL. Sulla.

T. Titus, Tribunus. TER. Terentius, or Tertium. TEMP. Temporum. TI. Tiberius. TR. or TREV. Treveris. TREB. Trebonianus. TR. MIL. Tribunus Militaris. TR. P. or TRIB. POT. Tribunitia Potestas.

V. Quintum. V. C. Vir Clarissimus. VESP. Vespasianus. VIB. Vibius. VICT. Victoria. VII. VIR. EVPL. Septemvir Epulonum. VIL. PVB. Villa publica. VIRT. Virtus. VN. MR. Venerandæ Memoriæ. VOT. X. MVLT. XX. Votis Decennalibus Multiplicatis Vicennalibus.

X. Decem, Denarius. XV. VIR. SACR. FAC. Quindecim Vir Sacris Faciundis.

*Abbreviations on the Exergue ; from Badnduri and Monalnii.*—Pinkerton.

A. Officina Prima. ALE. Alexandria. AMB. Antiochensis Moneta Secundæ Officina. AN. ANT. ANTI. Antiochiæ. ANB. Antiochiæ Secunda Officina ; to ANH.

Antiochiæ Octava Officina. A. P. L. (in officina) Prima percussa Lugduni. AQ. AQL. Aquileiæ. AQ. O. B. F. Aquileiæ Officinæ Secundæ Fabrica. AQ. P. S. Aquileiæ Pecunia Signata. AQ. S. Aquileiæ Signata. A. AR. ARL. Arelate. A. SISC. Prima (in officina) Sisciæ.

B. SIRM. Secunda Sirmii. B. S. L. C. Secunda Signata Lugduni.

C. Θ. Constantinopoli Nona. COMOB. Conflata Moneta Obryzo. Only on gold or silver from a gold dye. CON. Constantinopoli. CONOB. Conflata Obryzo. Only on gold. CONS. Constantinopoli.

KART. Carthago. K. O. Carthaginiensis Officina.

L. LC. LVC. LVG. Lucduni, Lugduni. L. LON. Londini. L. P. Lugdunensis vel Londinensis Pecunia. LVC. P. S. Lugduni Pecunia Signata.

MDPS. Mediolani Pecunia Signata. M. K. V. T. Moneta Kartaginensis Urbis (in officina) Tertia. M. L. Moneta Lugdunensis vel Londinensis. MOSTT. Moneta Officinæ Secundæ Treverorum. MSTR. Moneta Signata Treveris.

O. Officina. OFF. III. CONST. Officina Tertia Constaninopoli.

PARL. Percussa or Pecunia Arelate. PLON. Pecunia Londinensis. PLVD. G. Pecunia Lugdunensis. PR. Pecunia Romana, or Percussa Romæ. P. T. Pecunia Treverensis.

Q. AR. Quinta Arelatensis (officina.)

R. RO. ROM. Romæ. RA. Ravennæ. ROPS. Romæ Pecunia Signata.

S. AR. Arelate Signata. S. CONST. Signata Constantinopoll. SIS. Sisciæ. SS. P. Sisciensis Pecúnia. SISC. V. Siscia Orbs. SMA. Signata Moneta Antiochiæ. S. M. AER. Signata Moneta Heracleæ. S. M. N. Signata Moneta Nicomedæ. S. M. R. Signata Moneta Romæ. S. T. Signata Treveris.

TESOB. Tessalonicæ Officina Secunda. THEOPO. Theopoli. TR. Treveris Officina Secunda.

### *A List of Roman Colonies whose Coins remain.*

Abdera in Spain. Acci in Spain. Achulla in Africa. Ælia Capitolina in Judæa. Agrippina in Germany. Antiochia in Pisidia.—in Syria. Apamea in Bithynia. Arna in Thessaly. Astigi in Spain.

Babba in Mauritania Tingitana. Berytus in Phœnicia. Bibilis in Spain. Bostia in Arabia. Bracara Augusta in Spain. Buthrotum in Epirus.

Cabellio in Gaul. Cæsar-Augusta in Spain. Cæsarea in Palestine. Calagurris in Spain. Calpe in Spain. Camelodunum in Britain. Carrhæ in Mesopotamia. Carteia in Spain. Carthago in Africa. Carthago Nova in Spain. Cascantum in Spain. Cassandria in Macedon. Celsa in Spain. Clunia in Spain. Coillu in Numidia. Comana in Cappadocia. Corinthus in Greece. Cremna in Pisidia. Culla in Thrace.

Damascus in Cœlesyria. Dersosa in Spain. Deulton in Thrace. Dium in Macedon.

Ebora in Spain. Edesse in Mesopotamia. Emerita in Spain. Emesa in Phœnicia. Ergavica in Spain.

Germe in Galatia. Graccuris in Spain.

Hadrumetum in Africa. Heliopolis in Cælesyria. Hippo Regius in Africa.

Iconium in Lycaonia. Ilerda in Spain. Illergavonia in Spain. Illeci in Spain. Iol in Mauritania. Italica in Spain.

Laelia in Spain. Laodicea in Syria. Leptis in Africa. Lugdunum in Gaul.

Neapolis in Palestine. Nemausus in Gaul. Nesibis in Mesopotamia. Norba Cæsarea in Mauritania.

Obulco in Spain. Oca in Africa. Olba in Pamphylia. Osca in Spain. Osicarda in Spain.

Panormus in Sicily. Parium in Mysia. Paralis in Lycaonia. Patricsa (Corduba) in Spain. Pella in Macedon. Philippi in Macedon. Phillippopolis in Arabia. Ptolemais in Phœnicia.

Ruscino in Gaul. Romulo (Hispalis) in Spain. Rhesæna in Mesopotamia.

Sabaria in Hungary. Saguntum in Spain. Sebaste in Palestine. Segobriga in Spain. Sidon in Phœnicia. Signara in Mesopotmia. Sinope in Pontus. Stobi in Macedon.

Terraco in Spain. Thessalonica in Macedon. Traducta (Julia) in Spain. Troas in Phrygia. Turiaso in Spain. Tyana in Cappadocia. Tyrus in Phœnicia.

Valentia in Spain. Vienna in Gaul. Viminacium in Mœsia. Utica in Africa.

### *Abbreviations on Colonial Coins.*

ACCI Accitana Colonia, *Guadiz in Spain.* ADI. Adjutrix *legio.* EEL. MVN. COEL. Ælium Municipium Cœla, *near Sestos on the Hellespont.* AST. Astigitana, *Eceja* in Andalusia.

B. A. Braccari Augusti, *Prague in Portugal.*

C. A. Cæsarea Antiochiæ. C. A. A. P. or PATR. Colonia Augusta Aroe Patrensis. CAB. Cabellio. C. A. BVT. Colonia Augusti Buthrotum, *in Epirus.* C. A. C. Colonia Augusta Cæsarea. C. A. I. Colonia Augusta Julia, *Cadiz.* C. A. E. Colonia Aug. Enterita, *Merida.* CAL. Calagurris, *Calahorra in Spain.* C. A. O. A. F. Colonia Antoniana Oea Aug. Felix, *Tripoli in Africa.* C. A. PI. MET. SID. Colonia Æmilia Pia Metropolis Sidon. C. A. R. Colonia Augusta Rauracorum, or Colonia Asta Regia: Augst in Switzerland, or Ast near Xeres de la Frontera in Spain. C. C. A. Colonia Cæsarea Augusta, *Saragossa in Spain.* C. C. COL. LUG. Claudia Copia Colonia Lugdunensis. C. C. I. B. Colonia Campestris Julia Babba, *in Mauritania.* C. C. I. B. D. D. Colonia Campestris Julia Babba Decreto Decurionum. C. C. I. H. F. A. Colonia Concordia Hadrumetina, Pia Augusta. C. CIV. D. D. P. Corona Civica data Decreto Publico. C. C. N. A. Colonia Carthago Nova Augusta. C. C. N. C. D. D. Colonia Concordia, Norba Cæsareana, Decreto Decurionum. C. COR. Colonia Corinthus. C. C. T. Ducentesima Remissa. C. C. S. Colonia Claudia Sabaria, *in Hungary.* C. F. P. D. Colonia Flavia Pacensis Develtum, *Develtum in Thrace.* C. G. I. H. P. A. Colonia Gemelia Julia Hadriana, Pariana, Augusta. C. I. C. A. Colonia Julia Concordia, Apamea. C. I. A. D. Colonia Julia Augusta Dertona, *Tortona near Milan.* C. I. A. V. Colonia Julia Aug. *Cadiz.* C. I. AVG. F. SIN. Colonia Julia Augusta Felix Sinope. C. I. B. Colonia Julia Balba, *in Mauritania.* C. I. C. A. P. A. Colonia Julia Carthago Augusta Pia Antiqua, or Corinth, or Carthago

Of Abbreviations.

Nova. C. I. CAL. Colonia Julia Calpe, *Gibraltar.* C. I. F. Colonia Julia Felix, *Cadiz.* C. I. G. A. Colonia Julia Gemella Augusta. C. I. I. A. Colonia Immunis Illice Augusta, *Elche in Spain.* C. I. N. C. Colonia Julia Norba Cæsareana, or Alcantara; sometimes it means Col. Julia Nova Carthago. C. I. V. Colonia Julia Valentia, *Valencia in Spain.* C. V. T. Colonia Victrix Tarraco. C. L. I. COR. Colonia Laus Julia Corinthus. C. L. I. N. AVG. Colonia Laus Julia Nova Augusta, *Laus or Lodi in Lucania.* C. M. L. Colonia Metropolis Laodicea *in Cœlesyria.* CO. DAM. METRO. Colonia Damascus Metropolis. COHH. PRET. VII. P. VI. F. Cohortes Prætorianæ Septimum Piæ. Sextum Felices. COH. I. CR. Cohors prima Cretensis. COH. PRET. PHIL. Cohors Prætoriana Philippensium. COL. AEL. A. H. MET. Colonia Ælia Augusta Had. rumettina Metropolis, *in Africa.* COL. AEL. CAP. COMM. P. F. Colonia Ælia Capitolina Commodiana Pia Felix. COL. ALEX. TROAS. Colonia Alexandriana Troas. COL. AMS. or AMAS. Colonia Amastriana, *in Paphlagonia.* COL. ANT. *Antioch in Pisidia.* COL. ARELAT. SEXTAN. Colonia Arelate Sextanorum, *Arles.* COL. AST. AVG. Colonia Astigitana Augustana Augusta *Eceja in Spain.* COL. AVG. FEL. BER. Colonia Augusta Felix Berytus. COL AVG. FIR. Colonia Aug. Firma, *Eceja.* COL. AVG. IUL. PHILIP. Colonia Augusta Julia Philippensis. COL. AVG. PAT. TREVIR. Colonia Augusta Paterna Trevirorum, *Treves in Germany, sent from Paternum in Italy.* COL. AUR. KAR. COMM. P. F. Colonia Aurelia Karrhæ Commodiana Pia Felix, or Carneatum Commagene, or *Carrhæ in Asia.* COL. B. A. Colonia Braccara Augusta, *Brague.* COL. BEYT. L. V. Colonia Berytus Legio Quinta. COL. CABE. Colonia Cabellio. COL. CAES. AUG. Colonia Cæsarea Augusta, *in Palestine.* COL. CAMALODVN. Colonia Camalodunum, *England.* COL. CASILIN. Colonia Casilinum, *Castellazo in Italy.* COL. CL. PTOL. Colonia Claudia Ptolemais, *Acre in Phœnicia.* COL. DAMAS. METRO. Colonia Damascus Metropolis. COL. F. I. A. P. BARCIN. Colonia Flavia Julia Augusta Pia, Barcino *or Barcelona.* COL. FL. PAC. DEVLT. Colonia Flavia Pacensis Deultum, *Develtum in Thrace.* COL. HA. ME. T. Colonia Hadriana Mercurialis Thænitana, Mercuriali, *Fermo in Italy, and Thenes in Africa.* COL. H. (or HEL.) LEG. H. Colonia Heliopolis Legio Heliopolitana. COL. HEL. I. O. M. H. Colonia Heliopolis Jovi Optimo Maximo Heliopolitano. COL. IVL. AVG. C. I. F. COMAN. Colonia Julia Augusta Concordia Invicta Felix Comanorum, *drawn from Concordia in Italy, and sent to Comana in Cappadocia.* COL. IVL. AUG. FEL. CREMNA. Colonia Julia Augusta. Felix Cremna in *Pamphylia.* COL. IVL. CER. SAC. AVG. FEL. CAP. OECVM. ISE. HEL. Colonia Julia Certamen Sacrum Augustum Felix Capitolinum Oecumenicum Iselasticum Heliopolitanum. COL. IUL. CONC. APAM. AVG. D. D. Colonia Julia Concordia Apamea Augusta Decreto Decurionum. COL. IVL. PATR. NAR. Colonia Julia Paterna Narbonensis. COL. NEM. Colonia Nemausus. COL. NICEPH. COND. Colonia Nicephorium Condita, *in Mesopotamia.* COL. PATR. Colonia Patrensis or Patricia, *Patras in Greece,* or *Cordova in Spain.* COL. P. F. AVG. F. CAES. MET. Colonia Prima Flavia Aug. Felix Cæsarea Metropolis, *in Palestine.* COL. PL. F. AVG. CAES. METROP. P. S. P *same as above,* P. S. P. *is* Provinciæ Syriæ Palestinæ. COL. PR. F. A. CÆSAR. Colonia Prima Flavia Augusta Cæsarea, *in Palestine.* COL. R. F. AVG. FL. C. METROP. Colonia Romana. Felix Aug. Flavia Cæsarea Metropolis, *The same.* COL. ROM. Colonia Romulea, or *Seville.* COL. ROM. LVG. Colonia Romana Lugdunum. COL. RVS. LEG. VI. Colonia Ruscino Legio Sexta, *Roussillon in France.* COL. SABAR. Colonia Saburiæ. COL. SEBAS. Sebaste *in Palestine.* COL. SER. G. NEAPOL. Colonia Servii Galbæ Neapolis, *in Palestine.* COL. V. I. CELSA, or COL. VIC. IVL. CELSA. Colonia Victrix Julia Celsa, *Kelsa in Spain.* COL. VIC. IVL. LEP. Colonia Victrix Julia Leptis, *in Africa.* COL. VIM. AN. I. or II. &c. Colonia Viminacium Anno primo. *Widinin Servia.* COL. VLP. TRA. Colonia Ulpia Trejana; *Kellen,* or *Warhal, in Transylvania.* CO. P. F. CAE. METRO. Colonia Prima Flavia Cæsarea Metropolis. CO. P. I. A. Colonia Pacensis Julia Augusta, *or* Col. Octaviana. C. R. I. F. S. Colonia Romana Julia Felix Sinope. C. T. T. Colonia Togato Tarraca. C. V. IL. Colonia Vitrix Illice, *Elche in Spain.*

D. Decuriones. D. C. A. Divus Cæs. Aug. DER. Dertosa.

GEN. COL. NER. PATR. Genio Coloniæ Neronianæ Patrensis. G. L. S. Genio Loci Sacrum.

M. H. ILLERCAVONIA DERT. Municipium Hibera Illergavonia Dertosa, *Tortosa in Catalonia.* M. M. I. V. Municipes Municipii Julii Uticensis. M. R. Municipium Ravennatium. MVN. CAL. IVL. Municipium Calagurris Julia, *in Spain.* MVN. CLUN. Municipium Clunia, *Crunna in Spain.* MVN. FANE. ÆL. Municipium Fanestree Aelium. *Fano.* MVN. STOB. Municipium Stobense, *Sobi in Macedon.* MV. TV. Municipium Turiaso, *in Spain.*

N. TR. ALEXANDRINÆ COL. BOSTR. Nerviæ Trojanæ Alexandrianæ, Coloniæ, Bostræ, *in Palestine.*

SEP. COL. LAVD. Septimia Colonia Laudicea, *or* Laodicea SEP. TYR. MET. Septima Tyrus Metropolis.

Of Medallions.

*Of Medallions.*—The larger medals, now denominated medallions, were usually struck on any remarkable occasion, in testimony of rejoicing, or the like; and they were presented to the emperor, or by him to others, as beautiful specimens of workmanship. Of these, the best now known are of brass, but many are of copper, with a ring of brass, or *vice versa.* Few of the Greek medallions were struck before the time of the Roman emperors, and yet the Greek medallions are more plentiful than the Roman. In point of thickness, the Greek and Roman medallions differ materially; the latter being three or four lines thick, and the former rarely more than one. Both of these, however, are in very high estimation, insomuch, that few private individuals are able to procure them. The celebrated queen of Sweden, Christina, possessed 300 medallions; the French collection contains 1200; and Dr Hunter's invaluable collection 400, exclusive of the Egyptian. Those medallions named by the Italians *medaglion cini,* are somewhat larger than a half crown, and are very rare. The *missilia,* or medalets, are a still smaller kind, struck on graud occasions for the purpose of scattering among the people. A fourth class, distinguished by their thinness and faint relief, are by the Italians denominated *contorniati,* in allusion to the hollow circle with which they are surrounded, and are supposed to have been tickets for the public games. They are of some consequence on account of the portraits of illustrious men preserved on them.

*Modern Medals.*—In the Duke of Devonshire's collection is contained one of the earliest and best of the English medals. It is of a large size, and was discovered in Knaresborough forest. On the reverse of this medal is the Kendal arms, with the incription TEMPORE OBSIDIONIS TURCORUM MCCCCLXXX, and on the other side, is a portrait with 10 KENDAL RHODI TVRCVPELLERIVS. The gold medal of Henry VIII. is of the size of a crown, with the king's head and three legends on the obverse, and two inscriptions in Greek and Latin on the reverse, declaring him to be head of the church. This was closely imitated by Edward VI. Medals of Philip and Mary, of Elizabeth, of James I. and his queen, together with an excellent one of Charles I. and Henrietta are extant, but by no means equal to the antique. Those medals executed by the celebrated artist Simon are of very superior workmanship. Several excellent medals of Charles II. James II. and William III. are deservedly esteemed. In Queen Anne's time were issued gold, silver, and copper medals; the latter commemorative of the victories of the Duke of Marlborough. A fine series of copper medals representing the kings of England was executed in London in 1740 by Dassier. Indeed England may justly be considered as almost unrivalled among the nations of Europe in respect of rare and exquisite medals.

The first Scottish medals of gold are those of David II. struck between 1330 and 1370, but only two of them are known to exist, one of which is to be seen in the Hunterian museum. A medal of James III. in 1487, and one of James IV. in the collar of St Michael, are in good preservation. Various singular medals of the unfortunate Queen Mary are to be met with in cabinets, but seem to have been executed in France. The fine crown of Mary and Henry, in 1565, is remarkably rare. In one of the medals of Mary, she is represented weeping with the inscription, O GOD GRANT PATIENCE IN THAT I SVFFER VRANG; the centre of the reverse, QUHO CAN COMPARE WITH ME IN GRIEF, I DIE AND DAR NOCHT SEEK RELIEF; and around is this legend, HOURT NOT THE (figure of a heart) QUHAIS JOY THOU ART. The only medal coined of Scottish gold is the coronation one of Charles II. struck at Edinburgh June 18, 1663.

Subsequently to the first appearance of the Italian medals in the 15th century, this branch of art was rapidly improved; and besides the Papal ones, which are elegant, many have been issued by the different Italian states. Of the French medals, those of Louis XIV. are very superior, but frequently false. Danish medals are met with of Christian II. in 1516, of Frederic and Sophia in 1532, of Frederic I. and of Christian III. The principal Swedish medals are those of Gustavus Vasa, of Christina, and likewise of Charles XII. Dutch medals, which first appeared in 1566, are remarkable for maps and plans. Spanish medals began in 1503, and those of Germany in 1453. In Portugal appeared a medal relative to the luckless expedition of Sebastian into Africa in 1578. The first modern satyric medal is that of Frederic king of Sicily, in 1501, against Ferdinand of Spain. On one side of it is the head of Ferdinand, with this inscription, FERDINANDUS R. AR. VETUS VULPES ORBIS, and on the reverse appears a wolf carrying off a sheep, IVGVM MEVM SVAVE EST, ET ONVS MEVM LEVE.

Among the principal works on the Medallic science, are Frœlich, *Annales Regum et Rerum Syriæ*; Cary, *Histoire des Rois de Thrace et du Bosphore Cimmerien eclaircie par les Medailles*; Beauvais, *Histoire abregée des Empereurs Romains et Grecs,* &c. Banduri, *Numismata Imperat. Rom. &c.*; Ejusd. *De nummis Cretensium serpentiferis*; *Numismata Pontificum Roman.* and *Classes generoles,* &c.; Eckhel, *Doctrina nummorum veterum,* 8 vols. 4to. and other works, by the same excellent author; and Pinkerton *on Medals.*

*Explanation of the Figures in Plates* 139, 140.

Fig. 1. Gold medal of David II. of Scotland.
2. A coin of the Persian Sassanidæ.
3. A large noble of Edward III. being his first coinage.
4. Reverse of Adrian.
5. Reverse of Severus.
6. Reverse of Claudius, in first brass.
7. Reverse of Antoninus Pius.
8. Pescennius Niger, unique; in the Museum of the College of Glasgow.
9. Coin of the Arsacidæ of Parthia.
10. Reverse of Commodus.
11. Drachm of Egina.
12. Ancient penny of Scotland.
13. Ryal of Mary queen of Scotland.
14. Gold penny of Henry III.
15. Irish penny.
16. Penny of Robert the Great.
17. Silver coin of Caurausius.
18. The younger Tigranes of Armenia, with his sister.
19. Penny of William of Scotland.
20 Denarius of Cneius Pompey, reverse.
21. Daric of Persia.
22. Supposed to be an ancient penny of Scotland.
23. Brass coin of Cunoblinus.
24. A Saxon penny.
25. A Saxon styca.
26. Silver hemidrachm of Alexander the Great.

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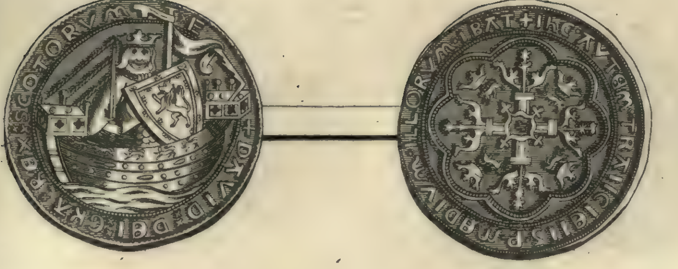

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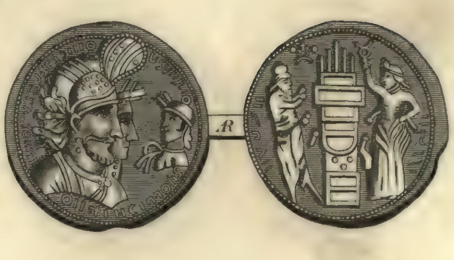

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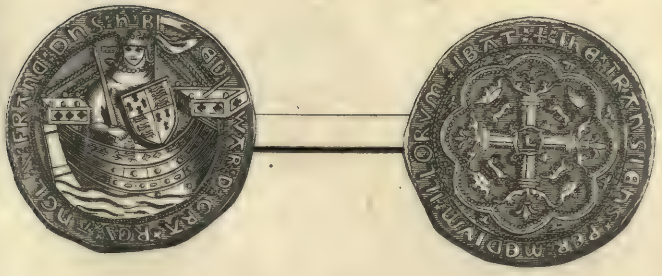

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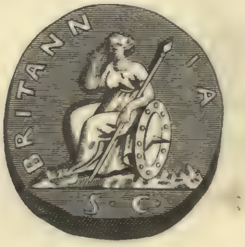

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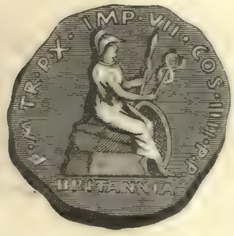
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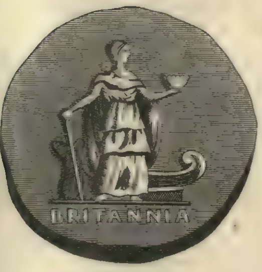

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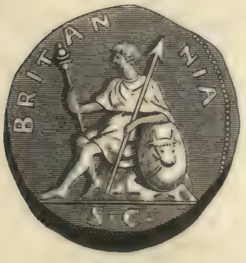

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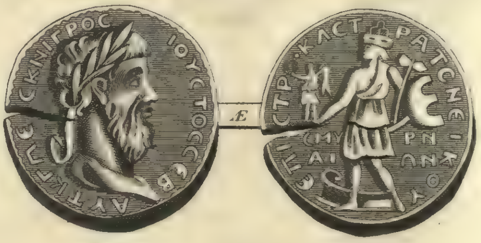

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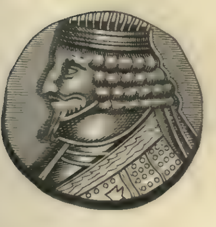

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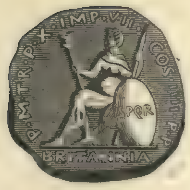
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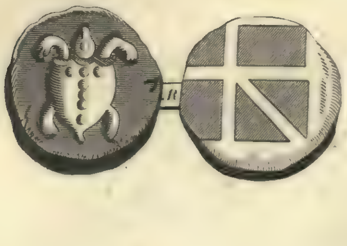

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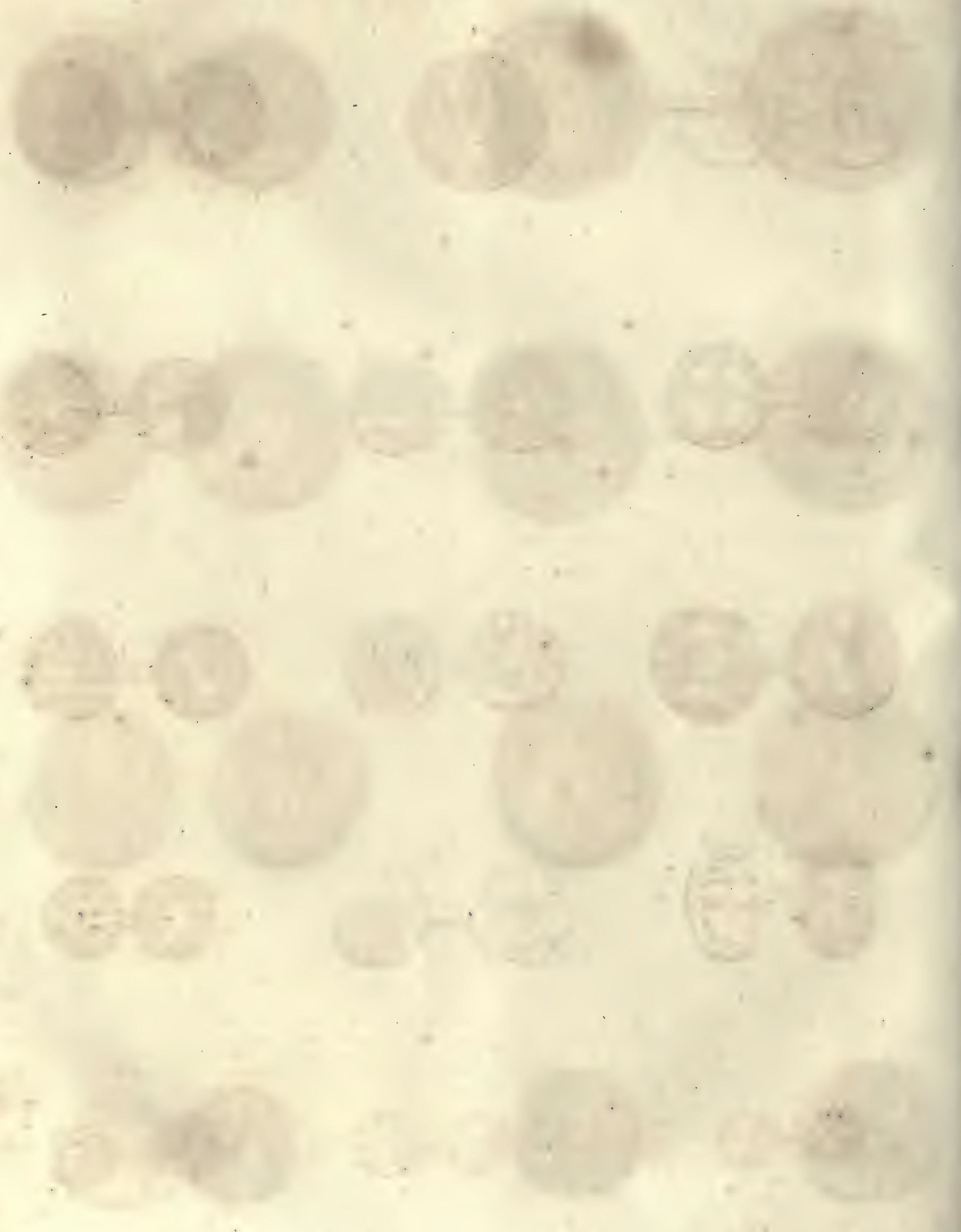

# NUMISMATOGRAPHY.

**PLATE 140.**

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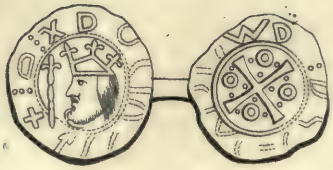

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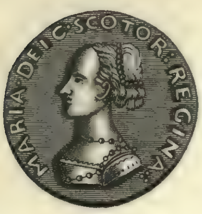
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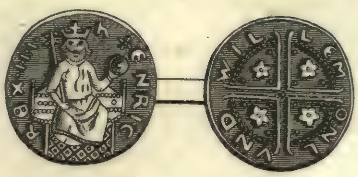

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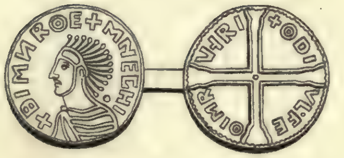

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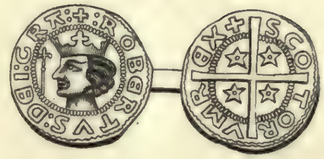

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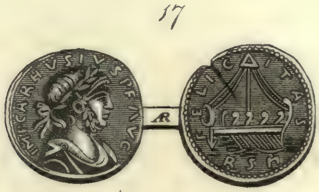
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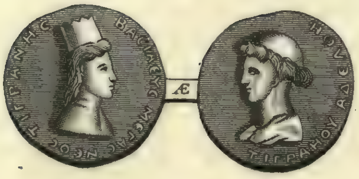

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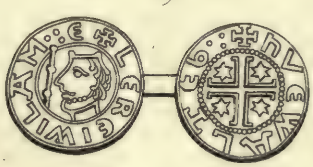

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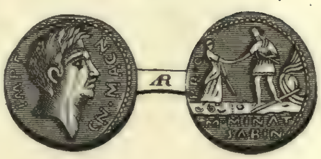

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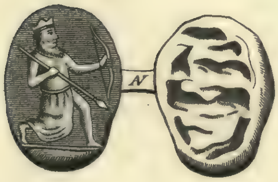

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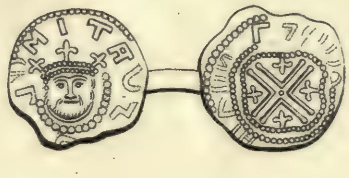

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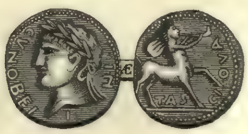

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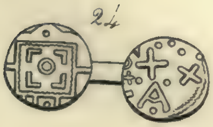

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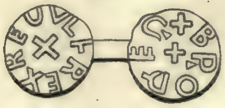

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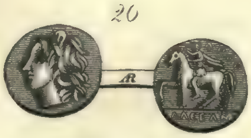


E. Mitchell sculpt.

NUN, a female who devotes herself, in a cloister or nunnery, to a religious life. See MONASTERY and MONK.

NUNCIO, or NUNTIO, a spiritual envoy from the Pope, or an individual who is appointed to attend on the Pope's behalf at a congress or an assembly of ambassadors.

NUNDINAL, NUNDINALIS, a term applied by the Romans to the eight first letters of the alphabet employed in their kalendar. The letters A, B, C, D, E, F, G, H, were placed, and repeated successively from the first to the last day of the year, and one of them always signified the market-days, or the assemblies denominated *nundinæ, quasi novendinæ*, in reference to their returning every nine days.

NUNEATON, a market-town of Warwickshire, situated on the river Anker, nine miles from Coventry, and 104 from London. It is well built, and has four principal streets, which meet at the market-place. The church, dedicated to St Nicholas, is a respectable Gothic edifice, with a square tower at the west end. The population is estimated at 5000. A considerable ribbon manufacture is carried on here. *Eaton*, signifying *the town on the rivulet*, was the original name of this place, and the addition *nun* was derived from the monastery for Benedictine nuns founded here in the reign of king Stephen.

NUREMBERG, a considerable town of Germany, formerly in the circle of Franconia, but now in the province of Retz and kingdom of Bavaria, stands in a plain, and is divided by the river Regnitz, which is crossed by different bridges. It is the *Mons Noricorum* of the ancients. Nuremberg is about three miles in circumference, and is encircled with an old wall, flanked with towers. Among the public buildings are the churches of St Marguerite, St Sibalde, St Egidien, St Catherine, and that of the New hospital, the Imperial chateau, Hotel de ville, Foundling hospital, and house of Correction, and the mills for driving the machinery of the copper-works. The town contains different useful institutions, the principal of which are the College of Medicine, the the Society for Promoting Industry, the academy of Painting, several Latin schools, and a valuable public library. The streets of this city are said to be 500 in number, its houses 8000, and its population about 27,000. Many important manufactures are carried on here, and articles of jewellery and toys are exported to all parts of the world. Nuremberg was one of the first cities that embraced Lutheranism, of which it retains the privilege in civil matters, not admitting any Catholics to the freedom or magistracy of the town.

NUTATION, in astronomy, a tremulous motion of the axis of the earth, first observed by Dr Bradley, whereby, in each annual revolution, it is twice inclined to the ecliptic, and as often returns to its former position. The moon, according to Sir Isaac Newton, has the like motion, though scarcely sensible.

NUTMEG, the kernel of a large fruit, not unlike the peach, the produce of a tree called *Myristica*. See BOTANY and MATERIA MEDICA.

NUX VOMICA, a round flat seed, about an inch broad, and a quarter of an inch thick, with a prominence in the middle, of a grey colour. It is the seed of the fruit of a large tree growing in the East Indies, and is of a very deleterious nature.

NYMPHS, in mythology, were certain inferior divinities, said to be the daughters of Oceanus and Tethys; so called because they always look young, or because they are handsome. They are distributed chiefly into three classes, celestial, terrestrial, and marine nymphs. The first of them, called *Uraniæ*, were those intelligences who guided the sphere of the heavens, and dispensed the influences of the stars to the things of the earth. The terrestrial nymphs, called *Epigeiæ*, presided over the woods, mountains, groves, meadows, and fields. The marine, or water nymphs, were the *Oceanitides*, the *Nereids*, the *Naiads*, and *Ephydriades*, and the *Limniades*. There were other nymphs besides these, who took their names from particular countries, rivers, &c. as the *Dodonides*, from Dodona; *Tiberiades*, from the Tiber; *Cithæroniades*, so called from mount Cithæron in Bœotia. All the gods had particular nymphs attending them.

# O

O, the fourth vowel and fourteenth letter of our alphabet, is pronounced long, as in *throne,* and short as in *not,* the long sound being implied by a servile *a,* or by *e* final. This vowel has likewise its soft sound chiefly in the middle of words, as *reproof;* and *oo* has sometimes the sound of *u* short, as in *flood.* To the Greek language belonged two O's, the omicron and omega, the former uttered sharply with the tip of the lips, and the latter more fully in the centre of the mouth. In the ancient Roman language O was sounded like U, the word *consol* being pronounced *consul.*

Among the ancients O signified eleven, or with a dash written above it thus, ō, eleven thousand. This letter also denoted triple time; because the ternary, which was thought the most perfest of numbers, was considered properly expressed by the circle, as the most perfect of figures.

The letter O is commonly affixed to Irish names, as O'Carrol; and this custom, Camden informs us, originated with the Irish lords as a mark of dignity.

OAK, *Quercus.* See BOTANY and GARDENING.

OAK-BARK is an article of great importance in the art of tanning; and tanner's bark is useful in gardening, as a manure for hot-beds.

OAK-LEAF GALLS, an excrescence formed by insects on different species of the oak and other plants. See CHEMISTRY and DYING.

OAKHAM, the principal town of Rutlandshire, with a market on Saturday, is situated in a fertile district called the vale of Catmose, and contains a spacious parish church contiguous to the ruins of an ancient castle. It communicates with Melton-Mowbray by means of a canal, and is 28 miles south-east from Nottingham.

OAKHAMPTON, a borough and market-town of Devonshire, seated on the river Oak, 24 miles west from Exeter; contains a population of 1440, who are chiefly employed in the manufacture of serges. It is governed by a mayor and eight aldermen, and sends two members to Parliament. The parish church stands on an eminence in the vicinity of the town, and the ruins of an old castle are likewise to be seen in the neighbourhood.

OAKHUM, or OAKUM, loose hemp obtained by untwisting old ropes, and employed by the ship-carpenter in caulking the seams, tree-nails, and bends of a ship, for the prevention of leaks.

OAR, an implement employed in rowing, and consisting of a long piece of wood formed thin and broad at one end for the cutting and resisting of the water, and round where it is to be held in the hand. In impelling a floating vessel with instruments of this description, the men turn their backs forward and work with them by the sides of the said vessel. The station on which the oar rests is in large vessels called the row-port, and in boats the row-lock.

OARISTUS, or OARISTYS, in the Greek poetry, denotes a dialogue maintained between a husband and his wife, such as that between Hector and Andromache in the sixth book of Homer's Iliad.

OASIS signifies a fertile spot situated in a desert country. See AFRICA.

OAT, AVENA, a genus of plants belonging to the Triandria class, and including the cultivated oat, with its varieties, the wild-oat, and some other species which are indigenous to Britain. See AGRICULTURE.

OATH, a solemn and corroborating appeal to heaven respecting an affirmation, a negation, or promise, and implying, in case of falsehood, a renunciation of divine favour as well as an imprecation of vengeance. An assertory oath is understood to confirm the testimony of individuals concerning any fact; and a promissory oath, which is in less frequent use, is taken as security of what is promised. As matter of security in courts of justice and the like, oaths are uniformly required by the laws of all civilized countries; but in a legal manner oaths can be administered only by a person properly authorised; and the administering of these by any other, subjects both to fine and imprisonment. Oaths are usually expressed in a precise form of words, and likewise accompanied with some bodily action. It was customary with the ancient Greeks and Romans, for parties contracting, to swear to perform what was right, while they held each other by the hand, or touched the altar of the divinity by whom they swore. The form of their oaths varied, however, according to different circumstances, and on very solemn occasions a victim was usually slain. Different Christian countries have their particular forms of oaths. According to the law of England, a corporal oath consists in the juror hearing or repeating the words of it while he holds his right hand upon a bible; and, after the usual conclusion of *so help me God,* he kisses the book. Preferable to this, perhaps, is the form of judicial oaths in Scotland, where the juror, holding up his right hand, swears *by Almighty God, and as he shall answer to God at the great day of judgment, that he will tell the truth, the whole truth, and nothing but the truth, so far as he knows, or it shall be asked of him.*

Legal oaths are by no means contrary to the dictates of the Christian revelation; yet on this head the Quakers and Moravians maintain serious scruples, and on no account whatever will they swear in any court of justice. But while the propriety of judicial oaths appears indisputable, it should be remembered, that the security supposed to be afforded by the administering of these depends materially on a due reverence being attached to them. The having recourse to oaths, therefore, on every frivolous occasion, seems rather impolitic; and Dr Paley has well observed, that " the levity and frequency with which oaths are administered, has brought about a general inadvertency to the obligation of them, which, both in a religious and political view, is much to be lamented."

OBAN, a town of Scotland, in Argyleshire, is seated on the sound of Mull, and is distant 38 miles west from Inverary. It contains 1000 inhabitants, and is a place of some trade. The harbour, which is defended from the westerly winds by the islands of Kerrara and Mull, is capable of receiving 500 sail of merchantmen. There is a regular ferry from this place to the island of Mull.

OBELISK, in architecture, a pyramidal structure usually rising from a pedestal to a considerable height, and erected in public places, in commemoration of some remarkable event, which is expressed by hieroglyphics or inscriptions.

OBJECT, in philosophy, denotes something which, by sensation or imagination, is presented to the mind. The term also coincides with subject implying the matter of an art or science.

OBJECT-GLASS, is the glass next the object in a telescope or microscope. See Optics.

OBJECTIVE LINE. See *Perspective* under Design.

OBIT, derived from *obitus*, death, is a funeral solemnity or office, performed while the corpse remains uninterred in the church. The same term signifies, in the Romish church, the yearly commemoration of the death of any individual. A register of the obits or obitual days of benefactors was kept in religious houses, and called the Obituary. The obit of King Childebert, founded in the abbey of St Germains Desprez, is among the most ancient in Europe. By 1 Edw. VI. c. 14. and 15. Car. II. c. 9. the tenure of obit or chantry lands became extinct.

OBITUARY, *Obitarium*, a term formerly applied to a register of the names and days of burial of those for whom obits were to be performed, but now signifying a statement of the particular circumstances attending the demise of any person.

OBLATE SPHEROID, a solid formed by the rotation of an ellipsis about its shorter axis. The figure of the earth is ascertained to approach to that of an oblate spheroid. See Astronomy and Geology.

OBLIGATION, in a legal sense, signifies a bond, (see Bond;) but, generally speaking, an obligation is that by which one person becomes bound to perform something to another, and is either natural, civil, or mixed. A natural obligation is founded solely on natural equity, a civil on civil authority, and a mixed one, besides being founded on natural equity, is by civil authority enforced.

OBLIQUE, a geometrical term, applied to any thing whose position deviates from the perpendicular, or from the parallel, to any given line or plane. Thus an oblique angle, or any angle except a right one, is either acute or obtuse. The term is variously employed in astronomy, dialling, geography, mechanics, and navigation.

OBLONG applies to a figure which has more length than breadth, as a parallelogram or an ellipsis.

OBLONG, or Prolate Spheroid, is a term used in contradistinction to the oblate spheroid, being a solid generated by an ellipsis about its longest or transverse axis. See Spheroid.

OBOLUS, a silver coin of ancient Athens, being the sixth part of a drachma, and of the value of a penny farthing Sterling. See Numismatography.

OBOLUS, a weight of ten grains, or half a scruple, which is used in medicine.

OBSEQUIES, sepulchral rites. See Burial and Funeral.

OBSERVATION, signifies the ascertaining of the various phenomena connected with the heavenly bodies, or the taking of the sun's or a star's meridian altitude, with the view of determining the latitude at sea.

OBSERVATORY, an edifice adapted for astronomical observations, and usually situated on an eminence. In almost every age and country, buildings of this kind have been constructed. It appears, too, that in different quarters of the globe, where the science of astronomy was cultivated, observatories were in use at a very early period. The lofty temple of Belus in Chaldea, and the celebrated tomb of Osymandias in Egypt, were devoted to astronomical purposes; and in the latter country the observatory of Alexandria was founded 300 years before Christ. Observatories are said to have been early known in China and Hindostan. The first regular observatory in Europe was built at Cassel in 1561; but previous to that, about the year 1540, Copernicus seems to have been the first European who set an instrument in the meridian. The famous observatory of Ticho Brahe was founded in 1576, in the island of Huen, (See Brahe.) Owing to their great national importance, observatories have been most liberally endowed in all maritime and commercial countries, and private as well as public observatories are now become very general.

*British Observatories.*—The Royal observatory at Greenwich, founded by Charles II. in 1675, and supplied with the most superior instruments, has attained great celebrity, in consequence of the invaluable observations and discoveries which have been there made successively by Flamstead, Halley, Bradley, Bliss, Maskelyne, and the present astronomer-royal Mr Pond. The buildings connected with this almost unrivalled establishment, occupy an elevated situation in Greenwich-park; and the observatory itself is an oblong structure, with four principal apartments on the ground floor. Of these apartments, the most easterly contains an excellent transit circle by Troughton, together with a fine clock by Hardy; the transit-room being the next, contains a most valuable transit instrument, the length of which is eight feet and axis three feet, and also an astronomical clock; the third apartment is furnished with a library, and is occupied by the assistant observer as a place for calculation; and in the quadrant room, which is the most westerly, two mural quadrants of eight feet each are fixed to a stone pier, and the zenith sector of Dr Bradely is suspended on the western wall.

The observatory at Oxford was commenced in 1772, pursuant to the ample bequest of Dr Radcliffe, and finished at an expense of L.30,000. It is also extremely well supplied with most valuable instruments, among which are two mural quadrants, a zenith sector, and a transit instrument, which, during the day, show small stars.

For the erection of a superb observatory at Cambridge the necessary arrangements have been made, and it is sincerely to be hoped that the work will ere long be finished. According to the estimates of Messrs Munday and Russel, the expense of erecting this desirable appendage to the university will amount to nearly L.8500.

Sir William Herschel's discoveries in the observatory at Slough, near Windsor, have given unparalleled celebrity to that institution; and it is worthy of remark, that all the discoveries of that inimitable astronomer and optician have been effected entirely through his own ingenuity in contriving instruments and proper apparatus. His telescopes vary in length from two to forty feet, and his larger instruments are necessarily mounted in the open air.

An excellent observatory is situated in Richmond Gardens, and was erected under the auspices of George III. in 1768.

Of the Scottish observatories, the most remarkable are those of Edinburgh, Glasgow, and Aberdeen. The New Edinburgh Observatory is an admirable structure, situated on the Calton-hill, and built according to the design of William Henry Playfair, Esq. architect. In 1736, was first formed the scheme of erecting an observatory on the top of the Calton-hill. This laudable proposal, having been interrupted in consequence of the Porteous mob, was in 1741 encouraged by the Earl of Morton, who bestowed L.100 for the purpose, and appointed Mr Maclaurin, professor of mathematics, and also the principal and several professors of the university, as trustees. This sum, chiefly through the instrumentality of Mr Maclaurin, was ere long augmented to L.300; but owing to the decease of that celebrated mathematician, the design was unfortunately again interrupted. The erection of the building was next encouraged by Mr James Short,—a person distinguished for his improvements in constructing reflecting telescopes, but who died in 1768. In 1776 the foundation stone of the observatory was at length laid by the Lord Provost of Edinburgh, and the building was finished in 1792, but by no means in a style adequate to the importance of the undertaking. In 1812, however, the formation of an Astronomical institution, gave rise to the new observatory already noticed, and which was founded a little to the east of the former in 1818, by Sir George Mackenzie.

The observatory of Glasgow is finely situated about a mile north-west from the cross, on Garnethill, and the building, according to the design of Mr Webster of London, consists of three compartments. This excellent institution owes its origin to a number of gentlemen who, in 1807, were associated as a society for the promotion of astronomical science, and who afterwards obtained a seal of cause from the magistrates and council, constituting them a corporate body. Of this society, the shares, amounting to 250, of L.20 each, are all heritable property. Besides the scientific observatory occupying the central compartment, and which is furnished with a superior azimuth and altitude instrument, capable of being fitted up as an equatorial, as well as with a sidereal clock, the east division is supplied, as a popular observatory, with proper instruments and books regarding the science; and the west division is chiefly occupied by the observer.

The new observatory of Aberdeen, raised in 1797 on the west wing of the college, is well supplied with instruments, among which are a transit of four feet, an equatorial, a quadrant of two feet radius by Troughton, an achromatic telescope of four feet, a reflecting telescope of ten feet, a clock having a gridiron pendulum, and a fine theodolite.

*Irish Observatories.*—In 1783 was founded the observatory attached to Trinity college, Dublin, by Dr F. Andrews, who made a handsome bequest for its erection. It is a superb building, favourably situated on an eminence, at the distance of nearly four miles north-west from the city. The dome, in the centre of this observatory, has a moveable roof for the equatorial instrument, and the width of the aperture for observation is two feet and a half. Behind the main building is conveniently erected the meridian and transit-room, which is very spacious, and furnished with the transit instrument and circle, properly supported on five pillars of Portland stone, and the excellent clocks, furnished by Mr Arnold, are also fixed to substantial pillars. The first professor in this establishment, Dr Usher, was in 1790 succeeded by the Rev. Dr Brinkley, who has made most important mathematical and astronomical contributions to the Philosophical Transactions, and the Transactions of the Royal Irish Academy. This eminent astronomer has been employed in a series of experiments for ascertaining the cause of those variations observed by him in the zenith distances of particular stars at different times.

The observatory founded and endowed at Armagh, in 1793, by the most reverend Richard Lord Rokeby, primate of Ireland, is a very respectable establishment, under the superintendance of James Archibald Hamilton, D. D. dean of the cathedral church of St Coleman, Cloyne. The buildings occupy the summit of a gently rising hill, and the principal instruments of the institution are an equatorial by Troughton duly elevated on a strong pillar, a transit, a ten feet sextant, one of Sir William Herchel's ten feet reflecting telescopes, a night-glass on an equatorial stand, and a five feet triple object-glass achromatic telescope.

*French Observatories.*—The Royal or Imperial observatory at Paris is a splendid edifice situated in the Fauxbourg St Jaques, and was erected between 1664 and 1672, under the auspices of Louis XIV. This building, being 90 feet in height, and the depth of the vaults 90 feet, it is consequently from top to bottom 180 feet. It has been augmented by the addition of new rooms, wherein are fitted up a large transit and circle; and on the top of the edifice a small observatory was formed in 1788, in which three observers were appointed by Louis XVI.

Besides the different observatories of Paris, others are established in different parts of France, especially at Marseilles, Toulouse, Dijon, Lyons, Montpellier, Avignon, Bourdeaux, Rouen, Montauban, Beziers, and Strasburg.

The *Italian Observatories* are numerous; the science of astronomy having been duly cultivated in Italy during the last century. At Rome there are different observatories besides that on the southern part of the Roman college founded by Cardinal Zelada, and which contains the large sector of Father Boscovich and other fine instruments. The observatories established at Bologna, Milan, Florence, Pisa, Turin, Venice, Verona, and Padua, are respectable institutions, in which many eminent observers have officiated. A magnificent observatory has been erected at Naples under the superintendance of M. Piazzi. It contains appropriate apartments for equatorials, telescopes, and other instruments; and the transit, meridian circle, repeating circle, and clock, are supported on pillars of stone.

Some of the islands in the Mediterranean contain observatories. The total destruction by fire of the observatory at Malta, where Chevalier d'Angos had, with the aid of the very best instruments, made invaluable discoveries prior to 1789, was a considerable loss to astronomical science. Piazzi's discovery in 1801 of a new planet, Ceres, has given celebrity to the observatory under his superintendance at Palermo in Sicily.

*German observatories.*—The observatory at Berlin founded in 1711 by Frederic I. of Prussia is superintended by an able astronomer, M. Bode, who is moreover known for having published a most excellent celestial atlas, together with a catalogue of the stars, and a history of the constellations. At Vienna the University observatory, founded about the year 1755 by the Empress Maria Theresa, is supplied with superior instruments. Gottingen observatory has maintained a high reputation under different observers, especially Harding, who in 1804 was fortunate in discovering Juno,—and the present observer M. Gauss. The other notable observatories in Germany are those of Konigsberg, Manheim, Cassel, Nuremberg, Bremen, Greissen, Leipsic, Lilienthal, Brunswick, and the observatory at Seeberg near Gotha, which is perhaps among the best in Europe.

Besides the observatories now enumerated, others in different parts of Europe are well worthy of notice. These belong to Hungary, Poland, Sweden, Denmark, Russia, Holland, Spain, and Portugal.

OBSIDIAN, or ICELAND, AGATE, a mineral production belonging to the siliceous genus. See GEOLOGY.

OBSTETRICS, or the obstetric art. See MIDWIFERY.

OBSTRUCTION, in medicine, an obturation of any organ of the body preventive of the circulation of the fluids, whether natural or morbid.

OBTUSE, a geometrical term signifying blunt, and used in opposition to acute, as an obtuse angle, an obtuse-angled triangle.

OBY, or OBA, the most considerable river of Siberia and of the empire of Russia, has its origin in the desert of Ischimska, whence it flows north-west and west by Kolivan, Narim, and Surgut, and being joined by the Irtysh from Tobolsk, then proceeds north and north-east, and after a course of about 1900 miles empties itself into the gulf of Obskaia. The Oby constitutes the boundary between Europe and Asia. In its course it is augmented by numerous rivers, and forms a number of islands. It is a very slow and expansive river, abounds in fish, and is navigable almost to the lake Altyn, where it takes its rise.

OCCIDENT, or OCCIDENTAL, signifying west or westward, applies to a planet setting after the sun. In geography the term denotes the western part of the horizon, where the ecliptic or the sun therein descends into the lower hemisphere.

OCCULT was a term applied to the futile sciences of magic, necromancy, cabbala, and the like. Some philosophers of former times, unwilling to be thought ignorant in respect to any thing, very aptly denominated those qualities of body or spirit, which baffled their most serious investigation, *occult*; and thus arose the phrase of occult qualities.

OCCULT, in geometry, denotes a scarcely perceptible line, of frequent occurrence in the drawing of plans, elevations, and the like, and which is commonly effaced after the construction is finished. The supplemental dotted lines connected with some geometrical figures are likewise called occult lines.

OCCULTATION, in astronomy, applies to any of the heavenly bodies when obsured to the view in consequence of the interposition of the body of the moon, or of some other planet.

OCCULTATION, circle of perpetual, an oblique sphere, wherein is a parallel distant from the depressed pole in the same proportion that the elevated pole is from the horizon. Between this parallel and the depressed pole, all the stars remain under the horizon of the place.

OCCUPANCY, in law, signifies the natural right attached to the first possessor of any thing, and, according to Blackstone, is the true ground and foundation of all property, or of holding those things in severalty which, by the law of nature, unqualified by that of society, were common to all mankind. But when once it was agreed that every thing capable of ownership should have an owner, natural reason suggested that he who could first declare his intention of appropriating any thing to his use, and, in consequence of such his intention, actually took it into possession, should thereby gain the absolute property of it; according to that rule of the law of nations recognised by the laws of the Romans, *Quod nullius est, id ratione naturali occupanti conceditur.* This right of occupancy, so far as it concerns real property, has been confined by the laws of England within a very narrow compass, and was extended only to a single instance, namely, where a man was tenant *pour autre vie*, or had an estate granted to himself, without mentioning his heirs, for the life of another man, and died during the life of *cestuy que vie*, or him by whose life it was holden. In this case, he that could first enter on the land might lawfully retain the possession so long as *cestuy que vie* lived, by right of occupancy.

OCEAN, the vast body of water with which the old and new continents are encompassed. See GEOGRAPHY, and *Hydrography* under GEOLOGY.

OCEANUS, in mythology, the father of the rivers and fountains, as well as of the Oceanides or Oceanitides, and styled moreover the father of all things, from the fanciful notion that he originated from Humidity, which the ancients supposed to be the first principle whence all things were produced. He was the son of Coelus and Terra, and the husband of Thetis, and was represented with the head of a bull, in allusion to the violent bellowing of the ocean.

OCELLUS, an ancient philosopher of the Pythagorean sect, was a native of Lucania, and flourished before Plato. He maintained that the universe was without beginning or end, and wrote a treatise in the Doric dialect, entitled The Universe, several editions of which, both in Greek and Latin, are extant. The Latin translators were William Christian and Lewis Nagarola.

OCHOTSK, or Okotsk, a maritime town of Siberia, in the government of Irkoutsk, and situated near the mouth of the Okhota, on a bay of the Pacific ocean, extends nearly in a line from east to west, and is a place of some trade. The merchants occupy a street which is close to the river, and has shops regularly disposed on both sides. A number of vessels sail yearly from the port of Ochotsk to America.

OCHRE, a mineral substance, which is found of different colours, but chiefly red and yellow, and is composed of fine soft argillaceous particles, which are readily diffused in water.

OCTAEDRON, or Octahedron, in geometry, one of the five regular bodies, being a solid, having eight equal and equilateral triangles.

OCTAGON, in geometry, a polygon with eight sides and eight angles. A regular octagon, which may be inscribed in a circle, has all the sides as well as all the angles equal. The term applies to a fortified place which has eight sides and eight bastions. See *Fortification*, under War.

OCTANDRIA, derived from the Greek, signifying *eight*, and *a man or husband*, is the eighth class in the Linnaean system of botany, consisting of plants which have eight stamens. See Botany.

OCTANT, or Octile, in astronomy and astrology, applies to the position of two planets, whose places are distant from each other by the eighth part of a circle, or forty-five degrees. The term also denotes an instrument for the taking of altitudes, distances, and declinations of the heavenly bodies.

OCTAVE. See Interval and Music.

OCTAVIANUS. See Augustus.

OCTOBER, the tenth month of the year according to the modern kalendar, was the eighth month of the Romans, and sacred to Mars. In compliment to the consort of Antoninus, the senate named it Faustinus. This month was also called Invictus, and from Domitian it had the name of Domitianus.

OCZAKOW, or Oczakoff, a strongly fortified maritime town of Russia, in the government of Catharinenslaf, is situated on the north side of the Dnieper, opposite Kinburn, and at the distance of 50 miles west from Cherson. The situation of this place renders it a key to the rivers Bog and Dnieper, and consequently of vast moment to the empire. In the sanguinary contests between the Turks and Russians for its possession, Oczakow has been subjected to different sieges; but, having been taken by the latter in 1788, under Suarrow, it was, by the subsequent peace, confirmed to Russia.

ODA, in the Turkish seraglio, denotes a class or chamber; the pages of the grand signior being divided into five orders or chambers. The youths composing the first and second odas are very numerous, and, being first instructed to read and write, they are trained to polite learning, and to the use of arms. The pages of the third chamber, amounting to two hundred, have particular exercises, and menial services assigned to them; those of the fourth, about two dozen in number, guard the treasure in the apartment of the grand seignior, and are denied pockets to their clothes; and those of the fifth, or privy-chamber, amounting to forty, wait in the chamber of the prince.

ODE, a poetical composition, adapted for music. The odes of the ancients were songs composed chiefly in honour of their gods; hence Horace emphatically says,

> "Gods, heroes, conquerors, olympic crowns,
> Love's pleasing care, and the free joys of wine,
> Are proper subjects for the lyric song."

Among the moderns, the ode is generally adapted to elevated and solemn subjects.

ODENSEE, the capital of the island of Funen, which is situated at the entrance of the Baltic. It is the seat of one of the richest bishoprics of Denmark, and, besides the cathedral and church, contains a school endowed by Margaret of Valdemar, and a gymnasium instituted by Christian IV. Odensee carries on considerable trade, especially in grain and leather, and has a population of 5200.

ODER, a river of Germany, which rises in the mountains of Moravia, and takes its course by Silesia, Brandenburg, and Pomerania; then passing some other places, forms the spacious lake of Gross Haff, not far from Stetten; after which it flows by means of three channels into the Baltic.

ODESSA, a maritime town in the government of Catharinenslaf, seated on a gulf of the Black sea, at the distance of 44 miles from Oczakow, is regular and well built, being the usual summer residence of the Polish nobility. It contains seven churches, an hospital, a theatre, together with the exchange, custom-house, and admiralty court. Several breweries and distilleries are established, as well as manufactories of woollen and silk goods, gunpowder, and soap. Considerable trade is carried on in hides, tallow, corn, flax, and timber, and in the importation of colonial produce.

ODEUM, in Grecian antiquity, a theatre for the rehearsal of music, and in which, according to Aristophanes, was held the competition for musical prizes, as well as a tribunal. The structure of this kind, built by Pericles, with the roof inclining downwards from a point in the centre, has been particularly celebrated.

ODIN, or Woden, the supreme divinity of the ancient Scythians. The appellation also applies to a Scythian prince who flourished about seventy years before the Christian era, and, in consequence of his successful conquests and wise government, had not only the greatest dignity, but also divine honours conferred upon him. The Norwegian historian, Snorro, represents that this person was a Scythian, who, with a number of others, had fled from the displeasure of the Romans, and, having conquered the northern nations, particularly Denmark, Norway, and Sweden, took upon himself the superintendence both of their religion and government. In the Icelandic chronicles, likewise, he is said to have been most persuasive and eloquent, to have invented the Runic characters, and to have been the first to introduce the art of poetry among the Scandinavians. It seems not improbable that he had officiated as a priest in his own country, and that the divinity, whose priest and prophet he continued to be after his great conquests, being called Odin, the name of the god and his priest became ultimately confounded, as well as the attributes of the one with the history of the other.

ODOMETER, or WAYWISER, an instrument which, by shewing correctly the number of rotations performed by the wheel of a carriage within a certain time, serves for ascertaining what extent of road has been travelled by the carriage. This ingenious instrument, Mr Hunter of Thurston has suggested, may be applied to a light iron wheel, in order to take the measurement of roads, hedges, walls, and ditches. Odometers are made by Messrs Howdens, watchmakers, Edinburgh.

ODYSSEY, an epic poem composed by Homer, and so denominated from the Greek name of Ulysses, whose adventures it embraces. This poem, Dr Blair remarks, wants the vigour and sublimity of the Iliad, and yet possesses so many beauties as justly to entitle it to high praise.

ŒDIPUS, a remarkable king of Thebes, whose history is much involved in fable, was the son of Laius and Jocasta. In consequence of the oracle of Apollo foretelling the destruction of Laius by Œdipus, it was deemed expedient to take the life of the child, who was, however, miraculously spared by means of the shepherd Phorbas, and taken care of by the queen of King Polybus at Corinth. When grown up, he was, by an oracle, instructed to go in search of his father in Phocis, whom, on his arrival there, he unwittingly killed in a rencounter; and having, not long after, solved the riddle of the sphinx, by which means he obtained the throne, he, unknown to himself, married his mother, Jocasta. These misfortunes affected him so grievously, that, under a sense of his wretchedness, he tore out his own eyes. He died B. C. 1228.

ŒNANTHE, WATER DROP-WORT, a genus of plants belonging to the Pentandria class.

OFFERINGS, among the Hebrews, consisted of the first fruits, the tenths, and the sin-offerings which were of obligation; or of vows, offerings of wine, oil, bread, salt, and the like, made to the temple or to the ministers of the Lord, which were called free-will offerings, or offerings of devotion. The latter were named *mincha* by the Jews, while all offerings in general were denominated *corban*.

In the church of England, four offering-days are observed, namely, Christmas, Easter, Whitsuntide, and the feast of the dedication of the parish church; and the sums allowed by individuals who receive the eucharist at Easter, as well as the usual acknowledgments in respect of marriages, churchings, christenings, and burials, are termed offerings. The Pagan worship consisted much in offerings, the most ancient of which consisted of wheat, flour, and bread.

OFFICE denotes a public charge, or the dignity connected with any public function, as the office of secretary of state, or that of a sheriff, or of a justice of the peace. The term also applies to any apartment for the discharge of public business.

OFFICER, an individual in the possession of a post or office, such as an officer of the crown, or of the army or navy. The great officers of the crown are noticed under HERALDRY, as well as in the order of the alphabet. Officers in the army are distinguished as follows:—General officers, including the general, lieutenant-general, major-general, and brigadier;—commission officers, or those appointed by the king's commission, which are all officers from the general to the ensign inclusive, and so called in contradistinction of non-commissioned officers;—non-commissioned officers, which are nominated by their respective captains, and appointed by the commanding officers of regiments, consist of serjeant-majors, quarter-master serjeants, serjeants, corporals, and drum and fife majors;—orderly non-commissioned officers are those appointed on duty for a particular week, and who, on beat of drum for orders, proceed to receive them in writing, as dictated by the adjutant or serjeant-major, in order to communicate them to the officers of the company, and warn the men to duty;—subaltern officers are lieutenants, cornets, ensigns, serjeants, and corporals.

OFFICINAL applies to such medicines, appointed by the college of Physicians, as are indispensably necessary in the shops of apothecaries.

OFFING, among mariners, denotes a part of the sea at some considerable distance from shore, and where, with a short wind, a vessel may easily clear all the points and head-lands: Thus a ship sailing out to seaward, is said to stand for the offing; but if another vessel appears farther out, while the former is sailing within sight of the land, that vessel is said to be in the offing.

OHIO, one of the United States of America, bounded on the north by the territory of Michigan and lake Erie, on the south by Kentucky, on the west by the Indian territory, and on the east by Pennsylvania and Virginia, extends above 228 miles in length, and 200 in breadth.

This country is finely diversified with meadows, hills, and streams, but is by no means mountainous. It enjoys a very salubrious climate, and, from the variety and richness of the soil, abounds in vegetable productions. In particular, that tract stretching from the Muskingum to the Scioto and great Miami rivers, is admirably healthful, and productive of all the necessaries of life. Wheat, oats, barley, rye, maize, flax, hemp, and cotton, are abundantly cultivated throughout the country; every species of culinary plants is produced in the gardens, and various kinds of grapes are plentiful, both in the high and low lands, from which the inhabitants are supplied with excellent red wine. Among the various kinds of trees may be mentioned the oak, of which different species are prevalent,—the horse-chesnut, iron-wood, cucumber, gum, and plumb trees, toge-

Ohio.

ther with the black and white walnut, black and white mulberry, sycamore, and maple. At a former period the country abounded with every description of wild game, and great herds of deer and wild cattle were common; the game is now, however, chiefly confined to bears, deer, turkeys, geese, and swans. Ohio is rich in mineral productions, especially iron, lead, copper, and coal; and the principal rivers belonging to it are the Ohio, the Muskingum, the Scioto, and the great and little Miami, all of which afford abundance of excellent fish. The productions of the country are forwarded chiefly by the Ohio and Mississippi to New Orleans. In return for the exports of flour, pork, bacon, hemp, whisky, peach brandy, pot and pearl ashes, furs, cheese, soap, candles, and timber, imports from the middle states are received, together with goods from the East Indies, and from Europe.

Ohio is divided into fifty-two counties, of which the capital is Columbus, and sends six members to Congress. The legislation of the state is comprehended in a senate and house of representatives. Liberal arrangements have been made by the government for the interests of education, by appointing one thirty-sixth part of the state as a grant for the support of schools, and granting charters for three universities. The amount of the whole population of the state, in 1816, was calculated at 450,000.

The country of Ohio contains some remarkable curiosities of antiquity, the chief of which are the forts, supposed to be at least 1000 years old, and the mounds of earth or tumuli, resembling the barrows of other countries. (See BARROWS.) Subsequent to the termination of the Indian war in 1795, the regular settlement of Ohio was effected by the treaty of Major Wayne with the Indian chiefs; and the state was admitted into the Union in the year 1802. See Brown's *Western Gazetteer*, and the *Edinburgh Gazetteer*.

OHIO, a river of the United States of America, which, taking its rise in the Allegany mountains in Pennsylvania, is known by the name of Allegany, until it is joined by the Monongahela at Pittsburg. In its course, it bounds the states of Ohio, Virginia, and Kentucky, and, after traversing an extent of nearly 1188 miles, discharges its waters into the Mississippi. The Ohio being pretty uniform, has an average breadth of about 600 yards, and its utmost width is 1200 yards. The navigation of this river, especially during low water, is somewhat embarrassed by a number of islands. During the great floods, however, between March and July, a first-rate man-of-war, it is supposed, might sail from Louisville to New Orleans, provided a convenient steerage were admissible by the current. The rapids of the Ohio, which, from the town of Louisville, have a fine appearance, are occasioned by a ledge of rocks crossing the bed of the river. Most of these rocks are visible during low water, when the channel admits only of flat-bottomed boats, which, from the dangerous situation, require the guidance of a judicious pilot. In the time of the inundations of the river, these rapids are only distinguishable by the very quick movement of the vessel.

OIL, an unctuous substance, obtained very copiously from animals and vegetables. See CHEMISTRY.

Oise
‖
Olea

OISE, a department of France, so called from the river of the same name, which forms a junction with the Seine below Pontoise. It includes part of the old province of the Isle of France, and is bounded on the north by the department of the Somme, on the south by the departments of the Seine and Marne, on the west by those of the Eure and the Lower Seine, and on the east by the department of the Aisne. Beauvais is the capital.

OLDCASTLE, SIR JOHN, Lord Cobham, styled *the Good*, in allusion to his remarkably amiable disposition, was the first English nobleman who suffered martyrdom. Having taken a most warm interest in the propagation of the reforming doctrines of Wickliffe, by distributing freely among the people the writings of that celebrated reformer, and likewise supporting itinerant preachers, he became obnoxious to the government, and was accused as a promoter of the sect called Lollards. Notwithstanding the insinuations thrown out against this excellent peer, King Henry V. with whom he had been a favourite, was anxious to secure his safety; but all arguments proving vain in the attempt to reclaim him to the Catholic faith, he was given up to the inquisitors, condemned for heresy, and committed to the Tower. He soon after effected his escape, and retired into Wales, where he remained concealed until the report of a conspiracy against the royal person occasioned a proclamation for his apprehension; in consequence of which, he was taken and burnt to death at St. Giles's in the Fields, in February 1418. Lord Cobham was the author of Twelve Conclusions to the Parliament of England.

OLDENBURGH, a duchy of Germany, and formerly a county connected with Delmenhorst, is bounded on the south by the principality of Munster, on the north by the German Ocean, on the east by the duchy of Bremen, and on the west by East Friesland. It is secured from inundation by means of very extensive dykes, and it abounds in pastures for the cattle and horses. Oldenburgh having, in 1667, devolved to the royal family of Denmark, was some years afterwards transferred to the grand duke of Russia; and it became a duchy in 1777, under the auspices of the emperor of Germany. The Lutheran principles of religion are prevalent among the inhabitants.

Oldenburgh, the capital, a strongly fortified town, with a citadel wherein the governor resides, is chiefly remarkable for a church containing the tombs of the counts of Oldenburgh, and is situated 22 miles west from Bremen.

OLEA, OLIVE TREE, a genus of plants belonging to the Diandria class, and of which different species are described. The *Europea*, or common olive tree, with spear-shaped opposite leaves, and erect, solid stems of the height of 20 or 30 feet, is much appreciated in the southern parts of Europe, particularly in France, Spain, and Portugal, where the oil obtained from the fruit constitutes an important article of commerce, and the green fruit is employed in pickling. Another species, the *Capensis*, or Cape box-leaved olive, has stiff, oval, and shining leaves, and the stems, which are numerous, are about seven feet high. These trees, being imported from Italy, are not unfrequent in the Italian warehouses about London. Olives have a very acrid taste, though, when pickled, they are greatly improved. The Provence olives are considered the best, the Spanish are the strongest and largest, and the Lucca olives are small and weak to the taste. From the most ancient times, the branch of the olive tree has been adopted as the symbol of concord.

OLEAGINOUS is a term applied to unctuous substances, as oleaginous fruits, from which oils are procured.

OLERON, an island of France, about twelve miles long and five broad, and situated on the west coast, is defended by a strong castle, and contains a population of 12,000. It is productive of corn and wine, and carries on several salt works, which prove lucrative. This island, which formerly belonged to the English, is celebrated for good seamen, and for the excellent maritime laws framed in it by Richard I. and known over Europe by the name of the *Laws of Oleron*.

OLFACTORY NERVES, in anatomy, the first pair of nerves proceeding from the medulla oblongata, and to which belong the sense of smelling.

OLIBANUM, a gum resin, the produce of the *juniperus lycia*, which grows in Arabia. See Chemistry and Materia Medica.

OLIGARCHY, from the Greek, signifying *few* and *government*, is a form of government by which the supreme power is entrusted in the hands of a few individuals; thus the states of Genoa and Venice may be considered oligarchies. There appears little or no difference, however, between an oligarchy and an aristocracy.

OLIO, or Oglio, the name of a favourite dish among the Spaniards, which is composed of a strange admixture of ingredients.

OLIVE-OIL, an oil obtained from the fruit of the Olea. It is not much unlike oil of almonds in quality, and has no remarkable taste or smell. The purest kind is procured from the ripe fruit by slight pressure, after which a coarse sort is got by the application of heat and more powerful pressure. From the aqueous and mucilaginous qualities of this oil, the preparers of it have to observe the precaution of applying a proper proportion of sea salt as a preservative from putrefaction; and it is sometimes found of an obviously saline taste, after a sea voyage, from the salt intermixing by means of the shaking of the vessel. Olive oil is applied to many valuable purposes in pharmacy.

OLIVET Mount, or Mount of Olives, in ancient geography, a mountain situated east from Jerusalem, and separated from it by the brook Kedron and the valley of Jehoshaphat, which extends from north to south.

OLIVIER, Claude Matthieu, a French writer, born at Marseilles in 1701, was bred to the profession of the law, in which he became eminent, and is chiefly known as the author of *L'Histoire de Philippe, Roi de Macedoine, et Pere d' Alexandre le Grande*, 2 vols. 12mo. He died in 1736. Besides his principal work, he wrote *Memoire sur les Secours données aux Romains par les Marseillois, pendant la 2de Guerre Punique; Memoire sur les Secours données aux Romains par les Marseillois durant la Guerre contre les Gaulois.*

OLYMPIA, in ancient geography, a city of Elis, in Greece, famous for the magnificent statue and temple of Jupiter Olympius, and situated between the mountains Ossa and Olympus. It is now an inconsiderable place called Longinico, and is 50 miles south from Lepanto.

OLYMPIAD, a period of four years, by which the Greeks kept their chronological reckoning, and so called from the celebration of the Olympic games every fourth year on the banks of the Alpheus near Olympia. This system of computing time is thought to have been discontinued about the year 440 of the Christian era.

OLYMPIC GAMES, or Olympics, among the ancient Greeks, were solemn games of five days continuance, which were celebrated every fourth year. See Greece.

OLYMPUS, a much celebrated mountain of Greece, between Macedonia and Thessaly, and which, in ancient times, was considered the most lofty mountain in the world. Its top, indeed, was imagined to reach the heavens, to enjoy perpetual spring, and to be the residence of the gods, where was held the court of Jupiter. The name Olympus applied to fourteen different mountains, according to Hesychius; and of these seven are noticed by geographical writers.

OMAR, the second successor of Mahomet, obtained the caliphate on the death of Abubeker, and soon enlarged his power by the force of arms. Having reduced the city of Jerusalem, and effectually subjugated Syria, he directed his forces, under the command of Armu, into Egypt, the capture of which country was also speedily effected; and after the submission of Alexandria, the famous library of that city was devoted to destruction. In no instance does it appear that the arms of this powerful caliph were unsuccessful, so that the Moslem empire under his reign became one of the most formidable monarchies in the world. Omar is said to have reigned ten or twelve years, and to have been of a remarkably temperate and pacific disposition. He was assassinated in the 63d year of his age by a Persian slave.

OMBRE, a game at cards, derived from the Spaniards, is usually played by three persons, but may also be played by two or by five.

OMBROMETER, or Rain Guage. See Pluviameter.

OMELET, or Amlet, the name of a pancake or fricassee used in Spain and France, and which is composed of eggs and other ingredients.

OMEN denotes an indication or presage of some future occurrence, drawn from words uttered without any view to prophecy, or from the observance of natural objects. See Augury and Divination.

OMENTUM, or Caul, in anatomy, a fatty membrane covering the intestines. From its resemblance in structure to a net, it has also the appellation of reticulum.

OMER, Chomer, or Corus, was a liquid and dry measure among the ancient Jews. As a measure of liquids, it contained ten baths, or 75 gallons and five pints, and as a dry measure it contained 32 pecks and one pint.

OMER'S, St., a populous and fortified town of France, in the department of the straits of Calais, stands on an eminence near the river Aa, and was formerly a bishop's see. The place is so called from a saint of the same name, who, in the seventh century, erected a monastery in it. St Omer's contains two magnificent churches, an hospital, and a college.

OMPHALEA, a genus of plants belonging to the Monœcia class, and of which there are four species, natives of Jamaica.

OMPHALOPTER, or Omphaloptic, an optic glass, convex on both sides, and denominated a double convex lens. See Optics.

ON, a city of ancient Egypt, alluded to in the sacred Scriptures. See Heliopolis.

ONEGA, a lake of Russia, in the government of Olonetz, is about 120 miles long, and 40 broad, and communicates with lake Ladoga by means of the navigable river Svir. The river of the same name takes its rise in Kargapol, and flows through a woody country into the White sea.

ONION, Allium. See Botany and Gardening.

ONOMANCY, or Onomancia, a sort of divination by means of the letters of a person's name, and in reference to which it was customary for the young men of ancient Rome to toast their mistresses as many times as their names contained letters.

ONONIS, a genus of plants belonging to the Pentandria class.

ONTARIA, a river of North America, about 600 miles in circumference, abounds in fish, and contains several islands, the principal of which are Wolf, Amherst, Gage, and Howe. It receives the waters of lake Erie, by means of the river Niagara, on the south-west side, and also the Onondago towards the south-east, and on the north-east it gives rise to the river St Lawrence.

ONYX, the name anciently applied to the agate. See *Calcedony*, under Geology.

OPACITY, a term opposed to transparency, and signifying that quality in bodies by which they are impervious to the rays of light. The term, when applied to the moon, planets, and comets, denotes their incapacity of giving out light without borrowing it from the sun.

OPAL, a species of precious stone belonging to the Siliceous genus. See *Mineralogy*, under Geology.

OPARO, an island discovered by Captain Vancouver, in the North Pacific ocean, and according to whose observation it consists of craggy mountains jutting out in different places towards the sea, and may be about six miles and a half in length. The inhabitants of this island are numerous, and resemble those of the Friendly islands both in appearance and language. They evince a hospitable disposition, and seem acquainted with the use of iron, esteeming it in preference to trinkets and the like. In the construction of their canoes considerable taste is displayed by them, but they are unavoidably narrow, as the island affords little or no large timber. Captain Vancouver did not land on the island, though he supposed there was good anchoring ground on the north-west.

OPEN Flank, that part of the flank screened from the enemy's fire by the orillon. See *Fortification*, under War.

OPENING of Trenches, the preparatory breaking of ground by the besiegers with the view of effecting their approach to the place beleaguered. See War.

OPENING of Gates, in astrology, signifies the separation of one planet from another, when it applies to a third bearing rule in a sign opposite to that ruled by the other planet.

OPERA, a dramatic composition, embracing in its representation the advantages of poetry and music, together with magnificent dresses and decorations. That an opera may appear consistent, and perfectly agreeable, much must depend on the choice of the subject, which should, of necessity, be one admitting, in some degree, of music in real life. But as sense and sound are two separate sources of gratification, the blending of superior poetry with exquisite melody tends to make the poet and musician lessen the effect of each other's production; and, therefore, while the English language has been considered not sufficiently harmonious for the music of the opera, a preference is generally given to the Italian language, from its being peculiarly adapted to convey the most charming sounds.

OPERA-GLASS, a perspective glass used by curious persons in theatres and the like. This instrument is composed of a tube, in which is a concave glass, near a plane mirror, placed diagonally, with a convex glass in an aperture in the side of the tube. By the application of the opera-glass to the eye, any object next to the aperture in the side will be reflected in a direct line forward, or in a position at right angles to the situation of the person looked at. The opera-glass possesses this material advantage, that in the using of it, none can be sensible who a person is taking cognisance of, and, indeed, the individual who uses the instrument is not himself aware if the object in view be on the right or left of him.

OPHIDIUM, in Ichthyology, a genus of fishes belonging to the Apodal order, and of which several species inhabit the Adriatic and Mediterranean seas.

# OPHIOLOGY.

Definition.

Ophiology, derived from the Greek οφις and σλογος, is that department of Zoology which treats of serpents, or of those animals which have the body more or less elongated and cylindrical, generally covered with scales or plates, and furnished with genuine ribs, but destitute of sternum, pelvis, feet, and fins. The tortoise, frog, and lizard tribes have been fully described under Erpetolgy; but the consideration of one of the French orders of reptiles, *Serpents*, was reserved for the present article.

The history of the serpentine tribes, as exhibited by Aristotle and Pliny, is vague and confused, and other writers of antiquity have blended it with allegorical and mythological fictions. Even in modern times, the repulsive aspect of most of the tribe, and the dangerous or fatal bites inflicted by others, appear to have repressed the zeal of investigation, and to have limited the number of naturalists who have studied their classification and habits. Among those who have contributed to the elucidation of their nomenclature and properties, we may mention the illustrious Linné, in his *Systema Naturæ, Amænitates Academicæ*, and *Adolphian Museum;* the Count de Lacépède, in his *Histoire Naturelle des Quadrupedes Ovipares*; the late Dr Shaw, in the third volume of his *General Zoology*; Blumenbach, in his *Berträg zur Naturgeschichte der Schlangen*; Schneider, in his *Allgemeine Betrochtungen uber die Entheilung und Kennizeichen der Schlangen*; Laurenti, in his *Specimen Medicum, continens Synopsin Reptilium*; Bonaterre, in his *Ophiologie*, in the Encyclopédie Méthodique; Latreille, in his *Histoire Naturelle des Reptiles*; Daudin, in his *Histoire Naturelle Générale et Particuliere des Reptiles*; Russell, on *Indian Serpents*; Brongniart, in his *Herpetologie*; and Oppel, in his *Memoires sur les Ophidiens*, inserted in the 16th volume of the *Annales du Museum d'Histoire Naturelle*.

## Anatomy and Physiology of Serpents.

Although serpents, from their internal organization, constitute the third class of the Linnæan system, they are, in their external form, more simple than most of the animals belonging to the three inferior classes. Their body, which is very long when compared with its thickness, is sometimes quite rounded or cylindrical, sometimes compressed on the sides, sometimes flat on the under surface, and sometimes attenuated towards the tail. Though generally invested with scales, it is sometimes naked, and either rough or slippery to the touch, and banded, spotted, or reticulated, the skin frequently displaying striking and elegant variegations in the tints and distribution of the colours.

The *head* is either distinct from the trunk or confounded with it, and of different forms, as convex, or flattened, oval, triangular, or heart-shaped, and furnished with plates or imbricated scales.

Of Serpents.

The *mouth* is very large in proportion to the size of the head, and is, in most cases, capable of being widely distended; for the jaws, which are either of equal or unequal length, are composed of two bones, which do not, as in the human subject, open in the manner of a pair of hinges, but are held together at the roots by a stretching muscular skin, and so attached that one may be moved independently of the other.

The *teeth* are generally sharp pointed, and, in the innoxious species, disposed in three rows, in the upper jaw, namely one exterior and two interior, and the under jaw is sometimes provided with a single row. The noxious kinds are furnished with canine teeth, or fangs, of a tubular structure, situated in the projecting portion of the upper jaw, commonly of a much larger size than the other teeth, and frequently accompanied by smaller or subsidiary ones. The fangs are inserted in a peculiar bone, so articulated with the rest of the jaw as to be elevated or depressed at the animal's pleasure, and thus not to interfere with the ordinary but important function of receiving food. When the creature is in a quiescent state, they are recumbent, with their points directed inwards; but, in the moment of irritation, their position is altered by the mechanism of the above-mentioned bone, and they become almost perpendicular. They are covered with a membranous sheath, and they receive the venom from a small reservoir which runs along the palate, and passes through the body of each fang, the green fluid, or poison, being, at every attempt to bite, expressed by a strong muscle fixed to the upper jaw. To such as form their ideas of the fangs of serpents from those of the rattle-snake, or even from those of the viper, it may seem strange that there should be any difficulty in distinguishing those weapons from common teeth; and, indeed, the distinction would be very easy were all the venomous species furnished with fangs as large as those of the kinds which we have just mentioned; but the fact is, that, in several cases, the fangs are just as small as ordinary teeth, and, consequently, cannot, by their size, be known from them. Hence Linné himself, and several of his followers, seem to have entertained vague and erroneous notions on this subject: Mobility, for example, which is mentioned as a test by the Swedish naturalist, is a very doubtful, if not a fallacious criterion; for Dr Gray, who made many experiments with a view to settle the difficulty, could never discover in genuine fangs any power of motion independently of that of the bone in which they are rooted. Some of them he, indeed, occasionally found loose in their sockets, but others, in the same individual, quite firm; and the same thing was observed by the Abbate Fontana and Dr Nichols, in the common viper, even during life. "The loose fangs," says the Doctor, "may be such as have not yet been firmly fixed in their socket, or they may have been loosened by some accident; for I suspect that the fangs may be at any time loosened, and even displaced, by a small degree of violence; and that, perhaps, may be one reason why there is always a certain number of small fangs near the base of the full grown, ready to enlarge and take their place, if they should be by any accident torn out." Linné, too, seems to have supposed, that the fangs were not only differently situated from the common teeth, but sometimes placed in the base of the jaw. Now, although they are inserted in the anterior part of the upper jaw, yet, as in serpents not venomous, common teeth are found in the same situation, recourse may, in cases of doubt, be had to the following simple trial: When it is discovered that there is some indication of teeth in the projecting part of the upper jaw, let a pin be drawn from that part to the corner of the mouth, and, if no more teeth are felt in that line, it may be certainly concluded that the first discovered are fangs, and, of course, that the serpent is venomous; whereas, if the teeth first discovered are found not to stand alone, but to be only part of a row, it may be as certainly inferred that the serpent is not venomous. In his preface to the *Museum Regis*, and in the introduction to the class *Amphibia*, Linné states the proportion of noxious to that of harmless serpents as one to ten; while, in the 131 species enumerated in his *Systema*, 23 are marked as poisonous, which is little more than one in six; and this more nearly approximates to the reckoning of some well informed naturalists. Among the many snakes which he examined in India, Mr Williams found only six that were poisonous; Daudin mentions 80 hurtful, and 233 innocuous; and of 43 species described by Russell, seven only are dangerous. It likewise deserves to be remarked, that of those which possess a poisonous quality, several do not prove fatal to man, though they may do so to smaller animals.

The *tongue* of serpents is usually straight and slender, composed of two long and fleshy substances, which terminate in sharp points, are rounded, very pliable, and white at about two-thirds of their length. The root of the tongue is connected to the neck by two tendons, which give to the whole organ a great variety and facility of motion. Pliny alleges that it is three-forked, and, when rapidly vibrated, it sometimes appears to be so to the eye. In most of the species it is almost entirely enclosed in a sheath or integument, from which the animal can dart it out of its mouth without opening the mandibles, the upper having a small notch for its passage. Some of the viper family have tongues a fifth part the length of their body, and, being in the habit of frequently thrusting them out, terrify those who are ignorant of the real situation of the poison.

The *eyes* are small, when compared with the length of the body, and they greatly vary in respect of liveliness and colour. In some species the upper eye-lid is wanting, while others have a nictitating membrane, or skin, which keeps the organ clean, and preserves the sight. In all, the crystalline humour occupies a large portion of the globe, the pupil is susceptible of considerable contraction and dilatation, and the iris is often of a golden or fine red hue.

The *nostrils* are two openings, at the extremity of the snout, for receiving the sensation of smell. In his description of the yellow snake of Martinico, the Count de Lacépède takes notice of an *orifice* on each side of the head, between the nostril and the eye, which some naturalists have conceived to be the external organs of hearing. From the subsequent observations, however, of Dr Russell and Sir Everard Home, it appears that these lateral openings, analogous, perhaps, to what have been supposed lachrymal organs in the deer and antelope tribes, have hitherto been found only in venomous serpents, namely, in sixteen species of *coluber*, and in three of *boa*. Sir Everard's investigations, which are reported in the 94th volume of the Philosophical Transactions, seem to have clearly established, that the lateral orifices, and the bags to which they conduct, have no communication with the organ of hearing. Another fact which that ingenious and indefatigable anatomist has ascertained is, that serpents characterized by lateral apertures have a cavity situated between the bag and the eye. The bags bear a relative proportion to the size of the snake, and are, like the eye-lids, lined with a cuticle, which forms the transparent cornea, making a part of the outer cuticle, and being shed with it: hence, when examined after the snake has cast it off, their shape is more perfectly seen than under any other circumstances.

The *trunk* is that part of the body which reaches from the nape to the vent, and comprehends the back, sides, belly, anus, organs of generation, and scales. The back is the upper part, commencing at the nape, and terminating immediately above the vent. In most species it is rounded, but in some carinated. The sides are the lateral portions of the trunk, from the extremity of the jaws to the vent. The belly, or abdomen, is the lower part of the body from the head to the tail, the want of a diaphragm precluding a breast. The anus is an opening, usually transverse, placed at the extremity of the lower surface of the trunk, forming the line of demarcation between the latter and the tail, and affording a passage to the liquid and solid evacuations. The penis of the male, and the ovaries of the female, are also situated in the common cloaca, from which they are extruded only during the season of pairing; so that, in most cases, the sex cannot be determined by external appearances. Various are the forms and disposition of the scales; thus vipers, boas, rattlesnakes, &c. have the upper parts of the head furnished with squarish plates, the upper parts of their body with small hexagonal scales, smooth, or slightly keeled, and distributed in a reticulated form, while their under parts and tail exhibit only long narrow bands, ranged transversely, sometimes entire, and sometimes consisting of two parts, alternately grooved, as it were, into one another; the *amphisbænae* have the whole body encompassed with narrow annulations, composed of minute square scales; the *accrochordi*, in place of scales, have their whole skin beset with small hard tubercles; and the *ceciliæ* present only a few folds or wrinkles on their otherwise defenceless skin. Almost all the scales which invest the bodies of serpents, and especially the larger plates which are situated on their under parts, are moveable independently of one another, being each furnished with its own muscle, and being thus capable of elevation or depression at the pleasure of the animal, and serving as a sort of imperfect foot, or point of support, during progressive motion over rough surfaces. The number of scales is not uniform in all the individuals even of the same species, and it seems to vary considerably according to age.

As serpents have neither limbs nor breast, the structure of their skeleton is much less complex than that of quadrupeds. The bones of the head are from eight to twelve. The skull, which is sometimes flat and sometimes convex, is very hard and compact, exhibiting four principal sutures, which are with difficulty separated. The occipital bone has the form of a triangle, with its apex turned towards the animal's back, but projecting less in that direction than among the other tribes of reptiles, and affording, in course, a less secure protection to the spinal marrow; and hence serpents may be readily injured, or even despatched, by a blow on the hind part of the head. The bones of the trunk consist of a series of vertebræ, incased in one another, and articulated with the ribs. The caudal vertebræ are disposed in the same manner, and provided with similar processes; but they are unconnected with ribs, and gradually diminish into small prominences as they approach to the end of the tail. In most quadrupeds the articulations of the back-bone seldom exceed thirty or forty, whereas, in serpents, they frequently amount to upwards of 300. In the boa, for example, are reckoned 52 costal and 252 caudal vertebræ, and in some of the vipers more than 60 costal and 244 caudal. The number of these joints must impart to the spine a surprising degree of pliancy, a property which is still increased by the manner in which one is locked into another; for whilst in man and quadrupeds the flat surfaces of the bones are laid one against the other, and bound tight by sinews, in serpents they play one within the other, like ball and socket, so that they have free motion in every direction. Thus, then, the serpentine skeleton may, in some respects, be assimilated to that of fishes, especially of the anguilliform families; but it is still more simple, being destitute of the bony apparatus of fins.

On the vigorous *muscles* with which serpents are provided depend their remarkable strength and agility. Of these several are inserted along and beneath the skull, and about the upper and lower jaws: four, which are denominated *lateral*, have their origin behind the head, and descend, by each side, to the extremity of the tail, whilst each vertebra has also its corresponding intercostal muscle, that serves the same purposes as in other animals. When we combine, therefore, their wonderful force and suppleness of muscle with the free play of their bony articulations, we may conceive how serpents, though destitute of feet, are enabled not only to glide rapidly along a smooth surface, by various undulations of their body, but also to leap and bound over a considerable space at once. To the same causes we have to ascribe the promptitude and energy with which they twine around objects, crush their victims in their spiral folds, ascend trees, twist about the branches, and maintain an upright attitude by supporting themselves on the tail, when agitated by anger, fear, or love. By drawing themselves into the arch of a circle, approximating the two extremities of the arched portion, and resting on one of them, they spring forwards or backwards, as circumstances may require, by unbending and flattening the curvature of their body; and, as often as they repeat this act, their progress is commensurate with the extent of the curve, and with the additional space that is traversed by the natural elasticity of the body, in recovering its horizontal position. The scaleless species move with nearly equal facility backwards or forwards; but the retrogade motion of the others is, in some degree, retarded by the unfavourable disposition of the plates. Sometimes, again, rolling themselves in a coil, and concentrating, as it were, the whole elasticity of their frame, they unbend in an instant, and spring over a space of several feet at once.

From the observations of Sir Everard Home, however, it would appear that the progressive motion of snakes is partly performed by means of the ribs. A coluber of unusual size having been brought to London for exhibition, happened to be moving briskly along the carpet, when Sir Joseph Banks thought that he saw the ribs come forward in succession, like the feet of a caterpillar. Sir Everard, to whom he communicated the remark, was speedily convinced of the fact, and with his fingers felt the ribs as they were brought forward; and when a hand was laid flat under the snake, the ends of the ribs were distinctly felt on the palm as the animal passed over it.

The *internal organs and viscera* of serpents pretty nearly correspond with those of individuals belonging to other classes of animals. The brain is divided into five small portions, which are round, and somewhat elongated. The two first are placed between the eyes, and give origin to the olfactory nerves; other two are seated in the region of the skull; and the last, which is a little further back, appears to be the commencement of the spinal marrow. The tracheal artery, or windpipe, composed of distinct and cartilaginous rings, has its origin at the top of the gullet, and communicates with the lungs under the heart. Its origin is of an oval form, and its direction is to the right side. After coming in contact with the lungs, it consists of demi-annulations, inverted, and connected with membranes attached to the lungs; and, lastly, where these demi-annulations terminate, the trachea unites with a membrane which draws in and receives the air, even at the commencement of the intestines, where the apparatus assumes the form of a small round bag.—The lungs are not lobed, but consist of a cellular and membranous substance, slender, transparent, of a somewhat reticulated appearance, slightly rugose, much longer than broad, and abundantly furnished with blood-vessels. The œsophagus is formed of a single membrane, extends to the orifice of the stomach, is of an equal diameter throughout, and susceptible of an extraordinary degree of dilatation, being destined to receive, in the first instance, the prey which these animals swallow entire. The stomach is lengthened, membranous, and so intimately connected with the bottom of the œsophagus as to seem only a continuation of that viscus, though it is much thicker, being formed of two strong, concentric tunics, which closely adhere, and the innermost of which is internally covered with folds or wrinkles.—Its orifice and middle are sufficiently capacious; but the bottom, which is turned to the middle of the body, is much contracted, and merely opens for the rejection of the fecal matter into the intestines. The heart, which is small in proportion to the size of the body, has two auricles and one ventricle.

As the circulation of the blood in serpents is independent of the lungs, they are enabled to remain for a considerable time under water; but they cannot make that element their permanent residence, because occasional supplies of fresh air are necessary to preserve in their blood those qualities which are essential to motion and vitality. Their respiration, however, is not performed by a rapid succession of alternate contractions and dilatations of the lungs; for, as the latter are very large in proportion to the body, they are able to fill them with a considerable provision of air, and as they expire very slowly some time will elapse before they are obliged to inspire again. Owing to this tardiness of respiration, and their extraordinary retention of the powers of life, they are capable of subsisting in mephitic and pestilential damps, which would prove destructive to most other animals.

On the right side of the body, and a little under the heart, is the liver, of a reddish-brown hue, and composed of two large lobes, of which the left is the shortest. The trunk of the *vena cava* is divided above into two branches, the most considerable of which terminates in the heart, and the other, passing under the lungs, reaches to the upper parts, while the lower portion of the trunk separates into various branches that descend to the inferior regions of the animal. At the side of the bottom of the stomach, and under the liver, is the gall-bladder, somewhat inclined to the left, and nearly of the form and size of a small bean in the viper. According to Charas, the gall of this species is of a very green colour, of a very bitter acrid taste, of the consistency of a thin syrup, and instead of being, as the ancients alleged, venomous, is indued with somewhat of a balsamic quality. The pancreas of the viper, which the ancients mistook for the spleen, is glandular and not fleshy. The intestines occupy the middle of the body under the dorsal spine, and immediately connected with the bottom of the stomach. Charas has remarked only three in the viper, the first and narrowest corresponding to the *duodenum*, the second, which is wide and very sinuous, is a genuine *colon*, and the last, or *rectum*, which is both very wide and straight, has its opening under the origin of the tail. The kidneys are particularly large, and composed of small continuous glands, blended with excretory vessels. That animals of the serpent tribe possess the use of the five *external senses*, can scarcely admit of dispute. It has, indeed, been remarked, that most of the species appear to want an external auditory passage; but it is certain that they are often directed to birds by listening to their notes, and that many of them indicate a degree of sensibility to the sounds of musical instruments. Their sense of smell, with a few remarkable exceptions, is neither very active nor acute; but, in most, that of sight is quick and penetrating. The soft and nervous texture of the tongue and palate would induce a suspicion that they enjoy pre-eminently the sense of taste; yet, as they swallow their food in large portions, they seldom avail themselves of the delicate structure of these organs. Being unprovided with feet, hands, or feelers, their sense of touch is probably very imperfect; and even when they twine very closely round an object, the interposition of their scales will render their feeling of its surface vague and obtuse. But however blunt or vivid may be the impressions which they receive of external objects, the sensibility of their feelings appears to be little inferior to that of the mammiferous animals, and of birds. After lying, for a long time, in motionless ambush, they may be seen to dart on their prey the moment that it comes within their reach: they are obviously, irritated when attacked, and, when opposed in their progress, they assume an air of haughty defiance; they boldly encounter a superior enemy, furiously assail those who disturb their combats or their amours, and defend their mates with extreme obstinacy. Not only do some of the species live in tranquillity near the dwellings of man, and familiarly haunt those very dwellings in quest of hurtful or annoying insects, but, when regularly domesticated, they have been known to exhibit signs of attachment and fidelity scarcely less wonderful than those manifested by the dog.

The *sexual union* of serpents usually takes place in the sunny days of spring, is very close and ardent, and varies in duration, from an hour to several days, according to the species; but it terminates without any permanent attachment. The females of some are oviparous, and of others viviparous. The eggs of the former vary in respect of size, colour, and number, according to the species and constitution of the individual; and they are deposited, not in continuous succession, but at intervals, and, sometimes, with the evident appearance of suffering on the part of the female. Segerus relates, that he saw a snake, after twisting herself, and rolling on the ground in an unusual manner, bring forth an egg. He immediately took her up, and facilitated the extrusion of thirteen more, during an hour and a-half. When he remitted his assistance, the process was more slow and difficult; and the parent seemed to receive his good offices with gratitude, which she expressed by gently rubbing her head against his hands. The mother never hatches these eggs, but leaves them exposed in some warm situation, as in holes that have a southern aspect, on dry sand, under moss or foliage, on a dunghill, near an oven, &c. The outer covering of the egg is a thin but compact membrane, and the young serpent is spirally rolled in the albuminous liquid. Thomas Bartholinus, having opened the eggs of a snake, found that each contained a small live one, for its heart had sensible pulsations. The placenta, formed of a great number of vessels, was attached to the yolk, or was rather a prolongation of it, terminating in the umbilical chord of the fœtus, pretty near the tail. The mother usually keeps watch in a hole, near the spot where she has deposited the eggs; and if a person tramples on them, she issues out, hissing with rage, or, if one changes them, she replaces them in the situation most favourable for warmth. The viviparous species differ considerably both with respect to their periods of gestation and the number of their offspring. Thus, vipers, which go about three months with young, generally breed twice a year, and produce from ten to thirty; while the blindworm, which is pregnant about a month, brings forth sometimes seven, and sometimes ten, at a birth. The eggs of vipers are contained in two membranous ovaries, and their size nearly equals that of those of the common sparrow. Each includes a young viper, which pierces the shell in the body of the mother, and, proceeding through the oviduct, comes out with the after-birth, from which the mother immediately detaches it. When the young are hatched, or produced, they are abandoned to the resources of their own instinct, and often perish before they have acquired sufficient experience to shun the snares that are laid for them by quadrupeds, birds, and reptiles.

In regard to *the stages of growth* in the different species, little precise information seems to have been obtained; and, although some arrive at a very large size, their dimensions have no doubt been much exaggerated. The young of the viper, at the moment of parturition, measures from twelve to fifteen lines; and between two or three years, it becomes capable of reproducing its kind. Adanson concludes, from ocular observation, that the largest serpent in Senegal may measure from forty to fifty feet in length, and from a foot to a foot and a-half in breadth. Leguat assures us, that he saw one in Java which was fifty feet long; and Carli asserts, generally, that they grow to upwards of forty feet. Livy and Valerius Maximus make mention of a monstrous serpent, which Regulus, with no small difficulty, subdued, near the river Bagrada, between Utica and Carthage. This overgrown object of terror is said to have darted on the soldiers who came to the river for water, to have crushed them with the weight of its body, and to have either pressed them to death in the volumes of its tail, or suffocated them with its pestilential breath. The hard scales of the skin rendered it, as was alleged, impenetrable to all the missiles that were aimed at it, and it became necessary to besiege it in form, and assail it with military engines. At length, after many unavailing efforts, a huge block of stone, launched with unerring direction, broke the monster's spine, and laid it prostrate on the earth; but still it was not despatched without serious apprehension, for even Roman soldiers dreaded to approach this novel enemy, which seemed formidable in the very agonies of death. Its skin, which measured 120 feet in length, was conveyed to Rome, where it was suspended in a temple, and where, according to Pliny, it still existed during the Numantine war. This was, possibly, a specimen of a large constrictor boa, whose prowess and dimensions may have been considerably exaggerated: yet it is not unreasonable to conceive that, in former ages, individuals of this tribe, much more ample than any now to be found, may have occurred, the increasing population and culture of most countries having gradually circumscribed their numbers, intercepted their requisite supplies of food, and precluded their attaining to undisturbed old age. Between the present extremes of a few inches and forty or fifty feet, there exist various intermediate dimensions.

In respect of *voice*, some serpents are apparently mute, and others have a peculiar cry; but hissing is the sound which they most commonly utter, either as a call to their kind, or as a threat to their enemies. In countries where they abound, they are generally silent in the middle of the day; but in the cool of the evening they issue forth from their retreats with continued hissings:

> Sibila lambebant linguis vibrantibus ora.

*Hybernation, &c.*—In the more northerly and temperate regions of the globe, the serpent tribes, towards the close of autumn, fall into a state of torpor, more or less profound, according to the greater or less intensity of the cold; and in this condition they remain nearly lifeless, until the approach of the vernal season reanimates their stiffened frame.—Spallanzani observed that, in the temperature of one degree and a-half below zero, the heart of serpents beat only twice in a minute, and that respiration was suspended. When removed to the temperature of 70, the heart soon recovered its action, and gave ten or twelve pulsations in a minute, and even 28 or 30 under higher degrees of heat. Soon after its resuscitation, the serpent works itself out of its old epidermis, by rubbing itself against the ground, or by wedging itself between any two substances that are sufficiently close to each other. The exuviæ drop off entire, being loosened first about the head, and they are always found inverted. It is some time before the scales acquire a sufficient degree of hardness to defend the animal against external injury; and, during this interval, it generally confines itself to its retreat. When arrayed and confirmed in its new garb, it sallies forth, full of life and lustre:

> Postquam exhausta palus, terraeque terrore dehiscunt,
> Exilit in siccum, et flammantia lumina torquens
> Sævit agris, asperque siti, atque exterritus æstu.
> Ne mihi tum molles sub dio corpore somnos,
> Neu dorso nemoris libeat jacuisse per herbas:
> Cum positis novus exuviis, nitidusque juventa
> Volvitur, aut catulos tectis, aut ova relinquens
> Arduus ad solem, et linguis micat ore trisulcis.

In this animated description, Virgil had, possibly, in his eye the species of viper on which Redi made his experiments, and which is so common in Italy. The three-cleft tongue may be tolerated in poetry, and the Mantuan bard, perhaps, believed that it moreover corresponded with fact.

*Geographical distribution of Serpents.*—Serpents preferably inhabit warm and temperate countries, and seem to multiply in both continents in proportion to the heat and humidity of the climate, and the quantity of unoccupied soil. They abound in the hot and waste territories of Asia, Africa, and America, particularly under the tropics, where vegetation is luxuriant. The northern temperate zone comprizes more of their species than the southern. There are about fifteen known species in Europe. Russell describes forty-three which are natives of Bengal and the coast of Coromandel. They swarm in South America; and owing, perhaps, to the superior humidity of the soil, they are more numerous in Louisiana, the Floridas, and the United States, than in Barbary, Spain, or Greece. Of three hundred and twenty species which have been particularised, America alone, according to de Humboldt, contains one hundred and fifteen. They absolutely pullulate in Guiana, on the Lower Oroonoco, at Nicuargua, at Panama, on the Cassiquare, &c. although, in these districts, the distinct species do not exceed five or six; yet, as they lay a great number of eggs twice in the year, their multitudes become formidable, insomuch that, when the natives set fire to the brushwood, whole legions of serpents come forth in dense columns, and moving in all directions, to the dismay of the inhabitants, who are sometimes compelled to fly before them. In cold countries, again, these creatures are rare, or unknown. On the ridges of the Cordilleras, they are not found beyond the height of thirteen or fourteen hundred toises, nor on the elevated table-lands of Santa Fe de Bogota, nor on the Andes, at Antisana, and Pichincha.

*Food.*—The masses of food which serpents are enabled to swallow would appear quite miraculous, did we not reflect on the lax structure of their jaws, and the viscid humour or saliva, which lubricates the crude morsel in its passage down an extensive œsophagus. In spite of these circumstances, however, the quantity of aliment is sometimes so volumnious that it sticks in the gullet, when only partly immersed in the stomach, and the animal lies stretched and nearly motionless in its retreat, till the swallowed portion is digested, and the extruded half introduced to undergo the same process. But, although serpents thus occasionally gorge themselves, as their blood is colder than that of most terrestrial animals, and circulates slowly, their powers of digestion are feeble and tardy in their operation, so that they are capable of enduring abstinence for weeks, or even months together. Nay, so tenacious are they of the vital principle, that they exist and grow in mephitic marshes, continue to breathe for a considerable time in the exhausted receiver of an air-pump, and frequently exhibit symptoms of life after one part of the body has been severed from the other. Thus Tyson informs us, that the rattle-snake which he dissected lived several days after its skin was torn off, and most of its viscera removed. Vipers are often kept in boxes for six or eight months without any food; and there are small serpents sent to Europe from Cairo, which live in glasses for several years, without eating at all.

*Poison.*—Various and contradictory opinions, conjectures, and fictions, have been advanced relative to the nature, action, and cure of serpentine poison. Among the vulgar errors connected with this topic, may be reckoned the sting in the tail, and the flowing of venom from the black forked tongue, and from the teeth in general. Towards the end of the 17th century, Ferdinand II., Grand Duke of Tuscany, invited Steno, Redi, and some other eminent men of science, to his court, with a view to investigate this important phenomenon in the animal economy. Redi, in particular, instituted a great variety of experiments, and arrived at some useful discoveries. When he either caused a living viper to bite a dog, or wounded the latter with the fangs of one newly killed, the event was the same; but if the bite was repeated, the effect became weaker, and at length was lost, the poison contained in the vesicle being exhausted. He remarked, that, when the teeth of serpents were extended to bite, they were moistened with a certain liquor, and that when the vesicle at the base was pressed, a drop of poison flowed to the point of the fang. When the virus, thus flowing from the vesicle, was received on bread, or a sponge, an animal bitten by the serpent received no more harm from the wound than from the prick of a needle, till after a few days, when the virus was secreted afresh; but, when an animal was wounded with the point of a needle dipped in poison, it was tormented with the same pain as if it had been bitten by the viper itself. Having preserved some of the poison in a glass, and totally evaporated the moisture in the sun, when the residuum was diluted with water, he found, to his great surprise, that it had the same effect as when recent. But the boldness of Jacob Sozzi, a viper-charmer, excited the astonishment of the learned; for, as they happened, in the Grand Duke's presence, to talk of the certain death which would attend the swallowing of viperine poison, Sozzi, confiding in his art, drank off a portion of it without hesitation, and with the same safety as if he had taken so much water. Most of Redi's Treatise on Viperine Poison is occupied in demonstrating that little or nothing was known of its real nature, and that the commonly received notions on the subject were false or erroneous,—a mortifying lesson to the pride of man, who, in this, as in a thousand other instances, arrives at some faint glimmerings of truth, through mazes of prejudice and darkness. To Redi we are indebted for the discovery of the real humour which communicates poison to the bite of the viper, and the experiments on which the discovery was grounded were, in general, conducted with great accuracy. He was mistaken, however, when he placed the seat of this deleterious fluid in the membrane that covers the fangs. Yet the error was currently repeated for half a century after, and usually conjoined with Dr Mead's false hypothesis of the saline nature of the poison. From the multiplied and persevering researches of Fontana, it appears that viperine poison is not fatal to all animals; that it kills neither vipers themselves, nor snakes, blind-worms, snails, or leeches; that it acts, though slightly, on tortoises; that it is neither an acid nor an alkali; that it yields no determined savour, and that it leaves in the mouth a sensation of astringency and numbness. There is reason to believe that it contains no salt, properly so called, because when it becomes dry it presents no appearance of crystallization, like those salts whose superabundant water has evaporated, but it shrinks, chaps, and crackles, separating into very minute portions, so as to exhibit, by its very delicate ramifications, a sort of net work, which has been compared to that of the spider's web. It retains its virulence for years in the cavity of the tooth, whether the latter be separated or not from its socket; but, when dried, and kept in an exposed situation, it loses its deleterious qualities in less than a year. Hence the propriety of caution in examining vipers and other noxious serpents that are stuffed or preserved in spirits, or in making use of clothes that have been bitten by them, individuals having, more than once, fallen a sacrifice to the indiscreet handling of the poison-fangs, long after the animal to which they belonged was dead, the virus having probably dissolved in the blood of the wound. Fontana has, moreover, proved that the viper's venom is perfectly innocent when applied to the nerves only, but that it acts immediately on the blood, destroying, through its medium, the irritability of the muscular fibres, and inducing death, more or less rapidly, according to the circumstances of the case. But he has also shewn that it is not uniformly fatal except to very small animals, and that it is more dangerous to the larger sorts according to the quantity of virus secreted, the frequency of the bites, the parts of the body on which they have been inflicted, and the high temperature of the atmosphere. A sparrow dies in five or eight minutes, a pigeon in eight or twelve, a cat sometimes recovers, and a sheep very often; so that a man has little reason to dread the consequences of a single bite in the climate of Italy, and still less in France or Great Britain. The hundredth part of a grain of the poison will kill a sparrow, whereas six times that quantity is requisite to kill a pigeon; and, according to the same estimate, three grains should prove fatal to a man, and twelve to an ox. But the vesicles of an ordinary viper seldom contain more than two grains, and even that quantity is not exhausted till after repeated bites. Even Fontana has not attempted to explain the peculiar quality which enables viperine poison to produce such marked effects on the animal system. Mr Boag, in a paper inserted in the sixth volume of the Asiatic Researches, endeavours to maintain that it acts by subtracting oxygen or vitality from the blood; but his experiments do not seem to confirm his theory. In moderation it may be swallowed with impunity, provided it comes not in contact with a wound; for, if introduced into the blood, the system becomes deranged and relaxed. We need scarcely add, that the poison of the rattle-snake, of the *cobra de capello*, and of some other serpents, is much more violent and formidable in its effects than that of the viper. The consideration of the antidotes, and the modes of cure, properly appertain to the art of medicine; and we shall be contented to state, that although oil, turpentine, ammonia, ligatures, scarification, excision of the wounded part, the exhibition of some particular plants, &c. have all been vaunted as specific and successful applications, yet their efficacy would require to be confirmed by a wider range of inductions.

Kempfer, Denon, and other travellers, have explained much of the quackery by which the Indian jugglers, the Egyptians, and others handle noxious snakes with impunity; and according to Mr Bruce, recourse is had to smearing the body with some preparation, which prevents their biting.

*Age.*—The natural term of the existence of serpents is not accurately known, their external conformation being too little varied to satisfy the observer of the identity of any individuals which he may have attempted to watch in the forest or other natural haunt of the species. The larger sorts inspire too much dread to be patiently contemplated, while the smaller, which also excite no uncommon apprehension or disgust, may often, both from their diminutive size, and the nature of their recesses, elude the search of those who are desirous of studying their physiology and native manners. Analogy would lead us to conjecture that the period of their life may nearly correspond to that of the term of the existence of the reptile families to which they are so closely allied, and that, on this principle, some of the larger species may complete a century, while the age of the smaller species may be compared to that of lizards or frogs. But, however this may be, the first failure of their strength is the almost immediate forerunner of their dissolution, because, when deprived of the requisite elasticity of frame to spring on their prey, and of the requisite force to combat their enemies, they shrink into their retreats, and die of hunger, or they are easily devoured by the ichneumon, the stork, and other powerful invaders, nature thus kindly absolving them from protracted infirmity, or from the long endurance of a painful and helpless condition.

*Alleged Fossil Serpents.*—Although we often hear vague rumours of the fossil remains of serpents, yet we cannot learn from authentic testimony, that such productions have ever been found. The term *snakestone* is, indeed, sufficiently familiar to our ears; but it is merely a popular and erroneous synonym of *ammonite* and *nautilite*, whose convolutions resemble the coils of a serpent. Some German dealers in fossils contrive to adapt to the outer extremity of these bodies the sculptured head of a snake, and thus impose on the unwary.

Having premised these general topics relative to the natural history of the serpentine tribes, we shall now proceed to give some account of the more common and remarkable species. To give a systematic detail of this order of *Amphibia*, would exceed the limits to which we are necessarily restricted. But, for further information on the subject, the reader is referred to Dr Fleming's *Philosophy of Zoology*, a work highly deserving of serious perusal.

*The Crotalus Horridus*, *Banded* or *Common Rattle-Snake*, is from three to four or five feet in length, and its greatest thickness is about that of a man's arm. Catesby mentions one which was eight feet long, and weighed between eight and nine pounds; but this was of an extraordinary size, and confessedly the largest which he saw. The prevailing colour is a yellowish-brown, marked with cross and irregular bands of a deeper shade, and two or three longitudinal stripes from the head down the neck, while the under parts are of a dingy brown, with many dusky variegations and freckles. The tongue is black, slender, and enclosed in a kind of sheath, from which it is darted forth and vibrated with great velocity. The rattle consists of a number of pieces inserted into one another, all alike in shape and size, hollow, and of a thin, elastic, brittle substance, and supposed to originate from the old epidermis of the tail, for they have no muscles, nerves, or ligaments. Their number, however, affords no certain criterion of the animal's age; for those which are most remote from the tail, become so dry and fragile, that they are very liable to be broken off and lost. The noise produced by this instrument has been much exaggerated; at least Sonnini, who compares it to the sound emitted by the rapid rubbing of two goose-quills on each other, assures us, that it is generally very feeble, and that he could never hear it beyond the distance of twelve feet. The odour of these snakes, however, which is very offensive, is, not unfrequently, perceptible at a very considerable distance, and seems to depend on the evolution of ammoniacal gas from the rapid decomposition of their animal food, impregnated, as it is, with their poison. They abound in America, from Brazil to near Lake Champlain, becoming torpid in winter, but continuing active all the year in those regions where the cold season is unknown. From the more populous districts, they gradually recede and disappear. They affect woods and lofty hills, especially where the strata are rocky or chalky, and along the sides of rivulets, preying on hares, squirrels, rats, reptiles, and such birds as seek their food on the ground. They lie in ambush in their spiral folds, and dart instantly, and with unerring aim, on any small animal that happens to venture within their reach. That the destined victim is usually petrified with terror at the sight of such a formidable foe, can easily be believed; but Dr Barton, Sonnini, and others, have satisfactorily proved that the fascinating power of the rattle-snake has no existence in fact. Some of these serpents have been rendered tame; but they generally refuse food, and die, in confinement. Horses and dogs express uneasiness at their presence, and cannot be induced to approach them; but the hog unceremoniously devours them with impunity. Man may encounter them without fear, for they neither fly from him nor attack him unless provoked; and he can easily despatch them by a single blow with a stick on the spine. Sonnini, at length, became so familiar with them, that he caught alive all those which he met with, and which were not too large to be kept in spirits of wine. The rattle-snake is viviparous, producing in June about twelve young, which, by September, acquire the length of nearly twelve inches.

Though the bite of this formidable reptile sometimes occasions a wound of an inch in breadth, it is scarcely felt at first, but, in the course of some seconds, a swelling, accompanied with shooting pains, takes place in the affected limb, and is diffused over the body; and frequently, in the short space of a few minutes, the wounded man or animal has ceased to exist. If the poison has entered an artery, the case is almost hopeless. A considerable degree of nausea is usually the first alarming symptom; the pulse becomes full, strong, and greatly agitated; the eyes are suffused with blood; a hemorrhage frequently proceeds from these organs, and from the nose and ears; large quantities of blood are sometimes thrown out on the surface of the body, in the form of sweat; the teeth vacillate in their sockets; and the groans and agonies of the unhappy sufferer too plainly indicate that the moment of dissolution is near at hand. According to Kalm, horses and cattle, when bitten, die almost instantaneously; but dogs are more able to resist the poison, some of them having been cured of its effects no fewer than five times. Men, too, he observes, may be cured of the bite, if remedies be speedily applied, and none of the large vessels be wounded; for, in the latter case, he considers death to be inevitable in two or three minutes. This traveller, moreover, remarks, that, as boots may be pierced by the fangs, it would be adviseable to draw over them large pantaloons of woollen cloth, with a long pile. The following, among other instances, may serve to shew that the infliction of the bite, however distressing, is not always fatal. A gentleman in Virginia having accidentally trampled on a rattle-snake, the latter bit him in the hand. Olive oil, the remedy most readily within reach, was immediately applied; the arm, which was beginning to swell, was tied up near the shoulder, and the wound well rubbed with the oil. By the help of these, and other precautions, he at length recovered, but not without experiencing various and dreadful symptoms for several weeks together. His arm, below the ligature, appeared of many colours, with a writhing among the muscles, which, to his terrified imagination, exhibited the motions of a snake under the skin. After the swelling had considerably abated, he was attacked by a fever, attended with delirium and great weakness, from all which, however, he recovered, though the spots on his arm continued during the summer. Don Tadeo Haenke, an intelligent chemist and naturalist, who has favoured the public with some interesting communications concerning the native productions of the province of Cochabamba, in South America, makes the ensuing remarks:—"All the preparations of sal ammoniac (muriate of ammonia) are in very general use, but especially the eau de luce, as the genuine specific against the bites of vipers and rattle-snakes. The different plants which are vaunted in America as powerful antidotes to these bites, such as the *aristolochia anguicida, bejuco, guaco,* &c. probably owe their virtue to the greater or less quantity of ammonia, which is indicated by their disagreeable odour. A circumstance has lately occurred among the Yungas of the town of la Paz, which proves, in a convincing manner, the virtue and efficacy of this remedy. An Indian bit by a rattle-snake has been perfectly cured, in a few days, by the external and internal use of volatile alkali alone, although he lay at the point of death, and betrayed the most dreadful symptoms. There is no country in the world where people are more exposed to the loss of life from the bite of these venomous animals than the hottest part of America; but, at the same time, I believe no place more abounds in the materials of the proper remedy. Here thousands of quintals of the substances best suited to the manufacture of sal ammoniac, and its numerous preparations, may be easily collected in the vast extent of the heights of the Andes, which comprizes nearly a thousand leagues, and where the want of timber compels the inhabitants to have recourse to the dung of the

# OPHIOLOGY.

**PLATE 141.**

*Fig. 3.*

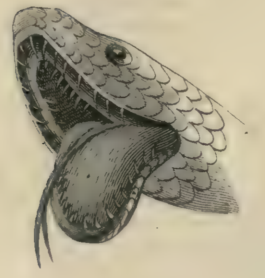


*Fig. 1.*

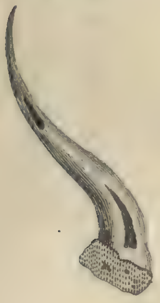


*Fig. 2.*

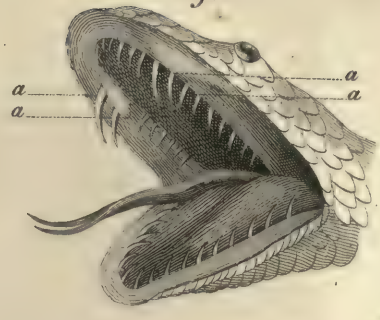


*Fig. 4. Crotalus Horridus, Banded Rattle-snake.*

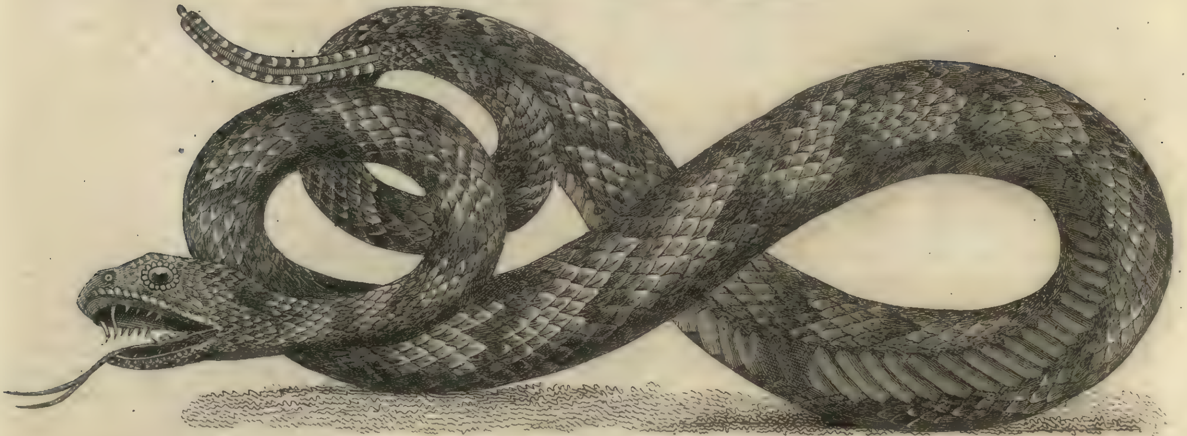
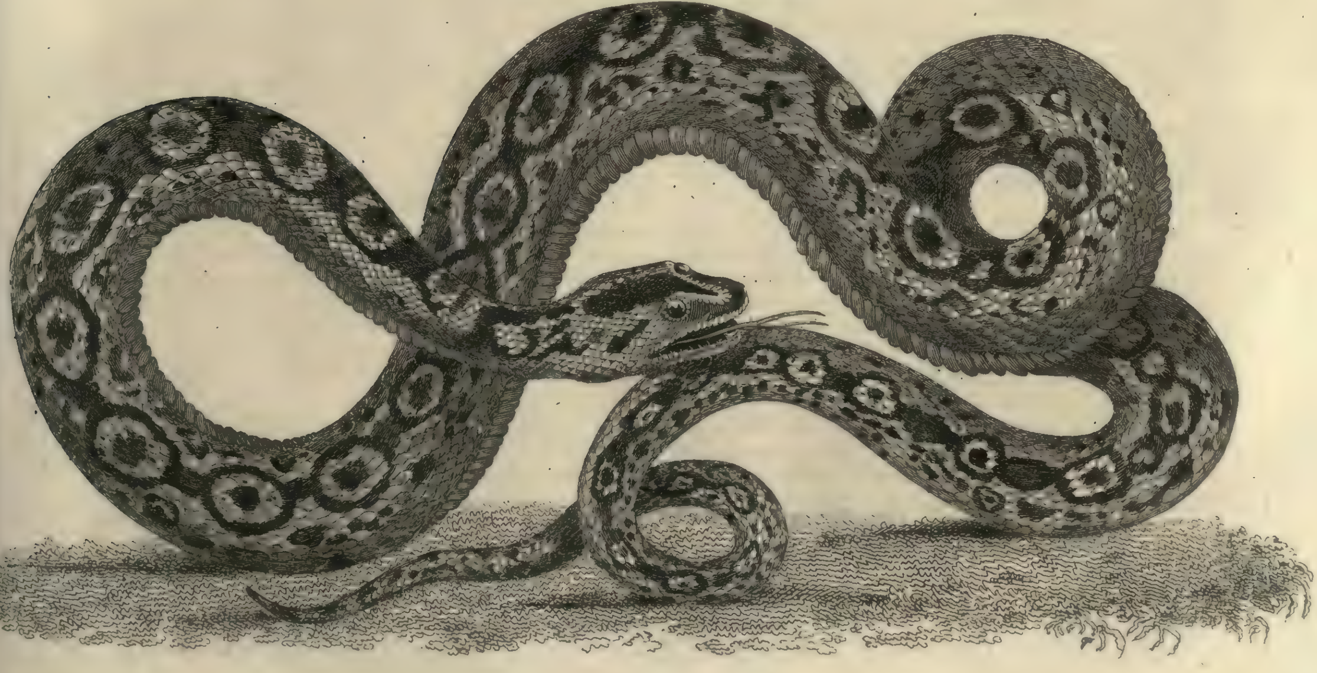


*Fig. 5. Boa Constrictor.*



E. Mitchell sculp$^{t}$

lama for fuel." We are informed by Dr Barton, that a gentleman of Philadelphia had a large rattle-snake brought to him alive, which he so managed by a string, that he could easily lead it into or out of a close cage. On the first day, he suffered it to bite a chicken, and the bird mortified and died in a few hours. On the second day, another chicken was bitten in the same manner, and survived the injury much longer than the first. On the third day, another victim swelled much, but, nevertheless, recovered; and, on the fourth, several were bitten without receiving any hurt. Such simple experiments enable us to assign a reason why persons who have been bitten by the rattle-snake have sometimes experienced very inconsiderable or no bad consequences from the wound; they shew in what manner many vegetables have acquired a reputation for curing the bites of serpents, without our being obliged to impeach the veracity of those from whom our information is derived; and they teach us the physiological fact, that the poison of this reptile is secreted very slowly.

In some districts of America, the rattle-snake is regarded with religious veneration by the natives; but in others, it is used as an article of food, being cooked as we do eels. The flesh is white, and said to be delicate.

The *Great* or *Constrictor Boa* is, among serpents, what the elephant is among quadrupeds, by far the largest of its tribe; for it measures from 30 to 40 or 50 feet, and sometimes attains to the thickness of an ordinary man. Its head is rounded at the apex, and covered with scales resembling those on the back; the forehead is elevated, and divided length-ways by a sulcus; the muzzle is elongated, and terminates in a large whitish scale, spotted with yellow, and notched inferiorly, to afford a passage for the tongue; and the stretch of gape is sometimes so enormous as to admit the head of a man, a stag, or even, it is alleged, a buffalo. The teeth are as strong as those of a large dog. The number of plates on the belly is about 246; and two rows of large hexagonal scales are disposed on each side of them. Those on the back have a similar form, but are more regular, and very small. The tail, which is about a tenth part of the whole length, is very hard and muscular, and furnished beneath with between 50 and 60 plates. The shades of this animal's colours are much varied, and very pleasingly distributed. The head is characterized by a large black or rufous spot, which is frequently in the form of a cross. Of other spots, symmetrically disposed on the back, some are of a golden yellow, though occasionally black or red, edged with brown; and others are of a chesnut nue, more or less clear, or of a very lively red, with dots at intervals, surrounded with a brighter circle, like eyes. The under part of the body is of a yellowish ash colour, marbled, or spotted with black. Different individuals, however, exhibit considerable diversities of marking, owing, perhaps, to age or sex, or to the different modes of preparing and preserving the skin in cabinets; for no naturalist, we believe, has hitherto distinctly described the boa constrictor from a specimen in life. It is also somewhat doubtful if the African, the Asiatic, and the American species be identical, although it is probable that they are distinct. The boa has neither rattle nor poison fangs, and, unless when stimulated by the calls of hunger, it indulges in sluggish repose, affecting caverns, tall grass, or jungles. When roused by the importunate cravings of appetite, it darts from its concealment with the rapidity of an arrow the moment that it espies its prey. Monkeys, deer, and antelopes, are often sacrificed to its voracity; and even the buffalo, the lion, and the tiger, have been entangled and entwined in its voluminous and powerful folds. "How, in fact," to adopt the language of Latreille, "oppose resistance to an animal 30 feet in length, which coils around you, applies so closely the surface of its body to your own, squeezes you with muscles so rigid in almost every point, paralyzes all your strength by precluding the action of your arms, hands, and feet, and, consequently, of the weapons which nature or art has put in your power? How not be stifled, crushed, and ground, by the power of so many levers, which act on all parts of your body? Add to this, that you are in the focus of a pestilential atmosphere, the breath of this serpent corrupting, to a great distance, the surrounding air; that your imagination, terrified at the sight of this monster, whose throat is gaping, which shews you its large teeth, which spreads on you a frothy and fetid slime, deprives you of the resources with which reflection might furnish you; and, as if this terrible aggressor had not of himself sufficient strength for your destruction, he makes use of trees and blocks of stone, that happen to be within his reach, as points of support, the more readily to crush you between them and his folds." If the boa misses its prey at the first spring, nothing can arrest its pursuit; for it crawls with the greatest velocity, clears, with a bound, a considerable space, swims like a fish, or climbs to the top of the loftiest trees. It is said to be particularly fond of the flesh of negroes, whom it sometimes swallows alive. It likewise allures fish, by disgorging into the water half digested morsels of its food, round which they assemble, and are instantly devoured. Before attempting to swallow the larger animals, it lubricates them with a mucilaginous liquor, kneads, and draws them out into length. The hardest bones crack under its pressure, and the mouth and gullet will receive substances that are thrice the dimensions of their ordinary capacity. When gorged with slowly digesting masses of aliment, it is deprived of its wonted agility, and falls into a state of drowsiness for days together, when the negroes, who reckon it dainty fare, despatch it without hazard. Yet it is an object of their worship, as it was of that of the ancient Mexicans. Its eggs, which measure only two or three inches in their largest diameter, are very small in proportion to the size of the animal.

The *Coluber naja*, *Cobra de capello*, *Spectacle*, or *Hooded Snake*, has about a hundred and ninety abdominal plates, and fifty-eight pairs of subcaudal platelets. Its general length is from three to four feet, of which the tail forms a sixth; and the diameter of the body is about an inch and a quarter. The head is rather small than large; and at a little distance from it is a lateral dilatation of the skin, extensile at the pleasure of the animal, and giving rise to the appellations *Cobra de capello* in Portuguese, and *Hooded Snake* in English. This part is marked above by a large conspicuous white patch, with black edges and black in the centre of each of the rounded portions, thus somewhat resembling a pair of spectacles. The ordinary colour of the animal is a pale ferruginous brown above, the under parts being of a bluish white, sometimes slightly tinged with pale brown or yellow; but its markings vary considerably, according to age, sex, and other circumstances. It is a native of India, in which it is far from uncommon, and in which several varieties of the species have been observed. It is an object of superstitious veneration among the Gentoos, who seldom name it without adding some respectful epithet, as the *royal*, the *good*, the *holy*, &c. Some of them take a pleasure in seeing it go from or enter into their houses, a pleasure, however, which is not always purchased with impunity; for it is very possible to hurt it unintentionally, when it immediately avenges itself with fury. It is attentive more than the other snakes to the sound of a certain flageolet or pipe. The jugglers play a monotonous, slow, and unharmonious air, which, at first, seems to create astonishment, and induces the creature to advance. It then rears itself, and extends its hood, remaining sometimes an hour in that attitude, indicating, by gentle inclinations of the head, that the sounds agreeably affect its organs. But before the shew-men handle it familiarly, they deprive it of its fangs. Such of the natives as travel bare-footed in the woods, are justly afraid of it; for it springs on them with great agility, and its bite produces certain death, unless the proper remedies are instantly applied. Dr Russell never knew its poison prove mortal to a dog in less than twenty-seven minutes, nor to a chicken in less than half a minute. Without meaning to detract from some judicious observations by that gentleman and Sir Everard Home, it may be proper to state, that the exhibition of the volatile caustic alkali appears, in various instances, to have effected a cure, when the bite of this, and of other noxious snakes, had induced the most alarming symptoms, as may be exemplified in the cases reported by John Williams, Esq. in the second volume of the Asiatic Researches. Of these we shall quote only two.

"In July 1782, a woman of the Brahman cast, who lived in the neighbourhood at *Chunar*, was bitten by a *cobra de capello*, between the thumb and fore-finger of the right hand. Prayers and superstitious incantations were practised by the *Brahmans* about her, till she became speechless and convulsed, with locked jaw, and a profuse discharge of saliva running from her mouth. On being informed of the accident, I immediately sent a servant with a bottle of the volatile caustic alkali spirit, of which he poured about a tea spoonful, mixed with water, down her throat, and applied some of it to the part bitten The dose was repeated a few minutes after, when she was evidently better. and in about half an hour was perfectly recovered."

"In July 1784, the wife of a servant of mine was bitten by a *cobra de capello* on the outside of the little toe of her right foot. In a few minutes she became convulsed, particularly about the jaws and throat, with a continued gnashing of the teeth. She at first complained of a numbness extending from the wound upwards; but no ligature was applied to the limb. About sixty drops of the volatile caustic spirit were given to her in water, by forcing open her mouth, which was strongly convulsed; in about seven minutes the dose was repeated, when the convulsions left her; and in three more she became sensible, and spoke to those who attended her. A few drops of the spirit had also been applied to the wound."

"I have seen," says the same gentleman, "instances of persons bitten by snakes, who have been so long without assistance that when they have been brought to me they have not been able to swallow from convulsions of the throat and fauces, which is, I observe, a constant symptom of the bite of the *cobra de capello*; and, indeed, I have had many persons brought to me who had been dead some time, but never knew an instance of the volatile caustic alkali failing in its effect, where the patient has been able to swallow it." Mr Williams is inclined to believe, that this remedy does not act so much as a specific in destroying the quality of the virus, as by counteracting its effects on the system, or, in other words, by stimulating the fibres, and by maintaining that degree of irritability which the poison tends to destroy.

The *Coluber berus*, *Common Viper*, or *Adder*, being a native of Europe, has been more accurately observed than most of the tropical serpents. Its abdominal plates have been reckoned at 155, and its caudal ones at 39 pairs, all of a bluish black hue, with the edges of a pale shade; but the numbers are liable to vary, as are the ground colours of the animal. The prevailing colour is bluish ash, or reddish grey. A sort of chain of blackish spots, occasionally uniting in a zigzag form, runs down the back from the head to the extremity of the tail. On each side of the body, there is also a row of small blackish spots, and there is a black line behind the eyes. The ground colour is deeper in the female than in the male. Its black belly, the great thickness of the heart-shaped head, the more abrupt termination of the tail, which usually measures about a seventh or eighth of the whole length, readily suffice to discriminate it from the common snake, with which it has been often carelessly confounded. We may add, that its motion is comparatively slow, and that it cannot twist its body with the same agility. Its ordinary length is about two feet; but it sometimes attains to three. Its eyes are very lively, with the iris red and the pupil black.

The viper generally frequents hilly, stony, and wooded districts, particularly where the soil is chalky, but rarely flat or marshy countries. Its most ordinary localities in France are the environs of Lyons, Grenoble, and Poitiers. It occurs in some parts of Great Britain, and even in Siberia. It is most visible in the fine days of spring, about nine or ten o'clock in the morning, and on hills with an eastern exposure, basking in the sun near a bush, and within easy reach of its retreat. It is more seldom seen during the heats of summer. It subsists on small quadrupeds, as mice and moles, or reptiles, lizards, frogs, and toads, and on small

*Fig. 6. Coluber Berus, Common Viper.*

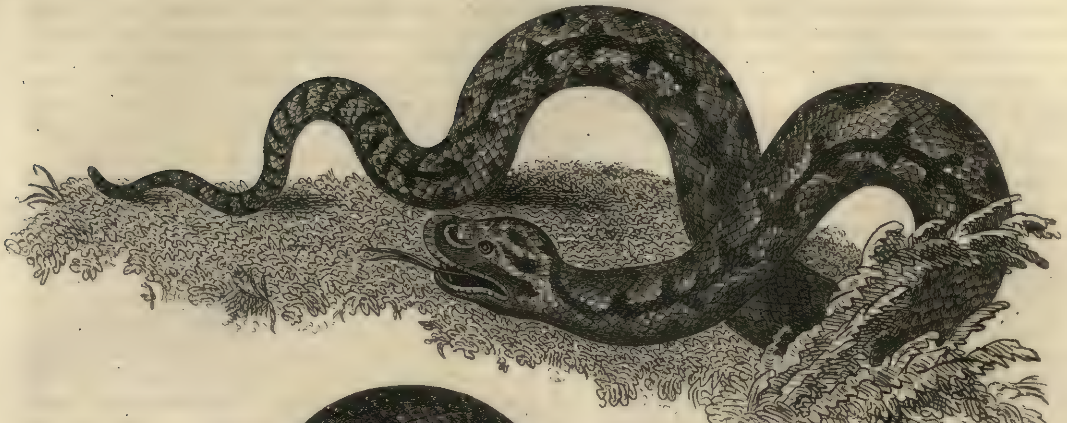


*Fig. 7. Cerastes.*

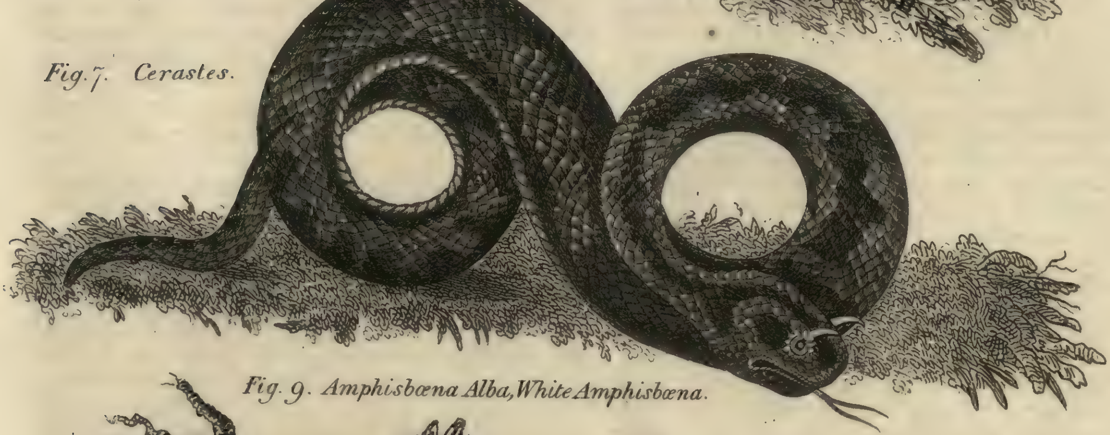


*Fig. 9. Amphisbœna Alba, White Amphisbœna.*

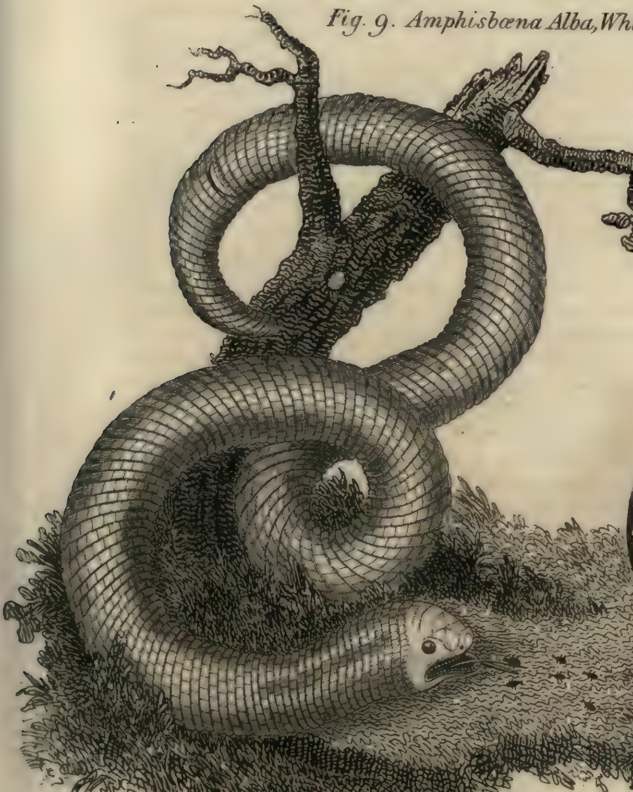
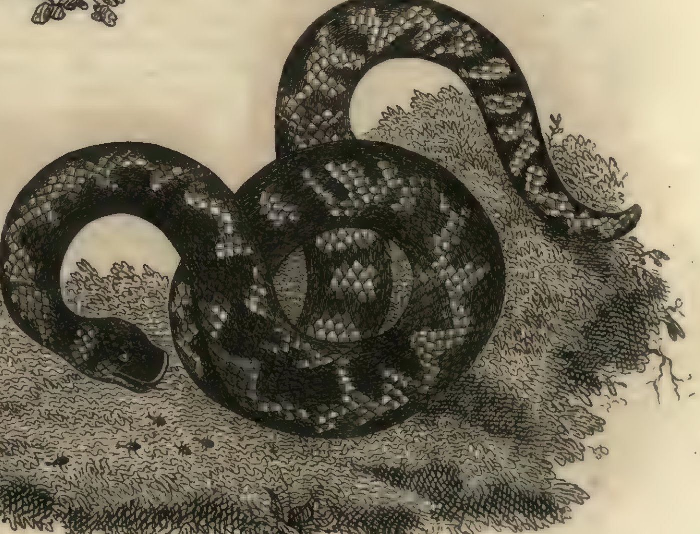


*Fig. 8. Anguis Corallinus. Coral Slow-worm.*



E. Mitchell sculp.

birds and insects, arresting them by its formidable bite, and swallowing them, when killed, beginning with the head. Professor Henon, having accompanied his veterinary pupils to *Mont Cindre*, about three miles from Lyons, on an herborizing excursion, happened to direct his attention to a bird's nest on a tree of considerable height, when he observed near the nest a thrush in a state of unusual agitation. Scarcely had he requested his young attendants to surround the tree, when they perceived at the foot of it a viper attempting to effect its escape. M. Henon, who requested them not to kill it, seized it by the head with a forked stick, opened it, and found in its body a young thrush still alive, but smeared over with a whitish froth, which would, no doubt, have speedily terminated its existence. No sooner was the little flutterer rescued from custody than the mother ceased from her convulsive motions, and quietly perched on the branches; and the professor caused the thrushling to be replaced beside its fellow nestling. Anxious to know the issue of this singular adventure, he took note of the spot, and, on the following day sent back two of his pupils, who reported that, having climbed the tree, they found both the young birds alive. So very dilatable are the jaws and gullet of this species, that it will sometimes swallow an animal four times larger than itself, which it digests very slowly. Thus, one which was taken by surprise, just after it had achieved the deglutition of a large toad, was found not to have completely digested it more than a month afterwards. It is likewise capable of enduring very protracted abstinence, as many of them have been kept in casks for two or three years, quite alive, without receiving any apparent nourishment. It changes its skin twice a year, namely, in spring and autumn, hybernates during the colder half of the year, is capable of sexual union in the second or third year, couples in the commencement of the warm season, and brings forth from about ten to fifteen live young, which are excluded from eggs within the mother, and measure, when produced, about three or four inches in length. During their first year, they live on insects, slugs, and very small reptiles; but, during the second, they have acquired sufficient strength to despatch the smaller quadrupeds and full grown frogs. The term of their existence has not been accurately ascertained, but is supposed to extend to many years, for though they may be easily killed by breaking their spine with a stick, they are otherwise very tenacious of the vital principle. When torpid in the fissures of rocks or holes in the earth, they may be handled with impunity; but, if warmed by artificial heat, they soon revive and resume their dangerous faculty of biting. They are usually taken with wooden tongs applied to the end of the tail, as, in that position, they cannot wind themselves up to injure their enemy; or they are caught by the neck with a forked stick, and thrown into a bag. Some of the catchers, holding down the head of the animal with the end of a stick, pinch its neck with the left hand, and while it tries to defend itself with its mouth wide open, extract the poison fangs, after which it may be handled with perfect safety. It has been remarked, that, in some quarters of the world where these creatures are treated with superstitious respect, as in Russia and Siberia, they have greatly multiplied; whereas in others, where they have been hunted for the use of the apothecary, their numbers have been very sensibly reduced in the course of half a century. Besides man, their known adversaries are far from numerous, being chiefly the wild boar, whose coating of fat possibly protects him from the mischievous consequences of their poison, and birds of the hawk and heron tribes, which can either resist or elude their bites; but most other wild animals are said instinctively to dread and shun them. They rather fly from man than attack him; but when accidentally trodden on, or molested, they naturally bite in self-defence. Their poison, however, which solely consists of the fluid secreted in the vesicle at the root of the fangs, and not of the froth or slaver of the animal when irritated, rarely proves fatal to the human subject, especially in cool climates; and its effects are most successfully counteracted by olive oil rubbed on the wounded part. The flesh of the viper was formerly in high esteem as a restorative, and prescribed for a great variety of maladies; but, in this country at least, it is now rarely recommended by the professors of the healing art. The best mode of instantly killing a viper, without altering its external form, is, to introduce a large pin into the cerebellum, at the occipital aperture. Charas, a French writer, has admirably illustrated the anatomy of this species; and Fontana, as we have already mentioned, has entered into the most elaborate details relative so the effects and cure of its poison.

*Coluber Natrix*, the *Common* or *Ringed Snake*, has 170 abdominal, and 53 pairs of caudal plates. The body is of a bluish-grey beneath, with four rows of black spots, of which those on the sides are the largest. There is, besides, a yellowish white patch on each side of the neck; length, from two to three feet. It is generally diffused over Europe, and may be met with on the margin of waters which it occasionally frequents. It affects, also, moist and warm woods, basks or sleeps in the sunshine, preys chiefly on frogs, mice, small birds, insects, worms, &c. and becomes torpid in winter. It easily climbs trees to surprise young birds, and swims with the greatest agility in quest of small fishes or aquatic reptiles. The female deposits from 12 to 40 eggs, about the size of those of the black-bird, and connected in a string, or chain, by a viscid matter, in dunghills, old hay ricks, or other warm recesses, near stagnant waters. The ignorance of the common people sometimes ascribes them to the domestic cock. The young come forth about mid-summer, and are about half a foot long before they enter on their first brumal slumber. Multitudes of them are sometimes found huddled together, in a dunghill, or other warm retreat, in winter. In March or April this species casts its skin so completely that the spoil exhibits even the exterior pellicle of the eye. It would be a most entertaining sight," observes the Reverend Mr White of Selborne, " could a person be an eye-witness to such a feat, and see the snake in the act of changing his garment. As the convexity of the eye in the slough is not inward, that circumstance alone is a proof that the skin has been turned; not to mention that now the present inside is much darker than the outer. If you look through the scales of the snake's eye from the concave side, viz. as the reptile used them, they lessen objects much. Thus it appears, that snakes crawl out of the mouth of their own sloughs, and quit the tail part last, just as eels are skinned by a cookmaid." The common snake, when irritated, hisses, darts out its tongue, emits a very fetid odour, and endeavours to bite; but, being destitute of poison fangs, it can inflict no dangerous wound. Instances have even occurred of its being rendered tame and domestic. The country girls in Sardinia are very partial to it, frequently keeping more than one of them with great care, preparing their food, and even feeding them. Being considered by the common people of that island as lucky, they are never driven from their doors lest their good fortune should at the same time forsake them.

*Anguis Fragilis*, the *Common Slow-Worm*, *Blind-Worm*, *Glass-Snake*, or *Long Cripple*.—This species has about 135 minute scales under the belly, and the same number under the tail. Black, yellowish ash, or rufous grey, the sides streaked with black and white: but the details of the colouring are so very variable, that scarcely any two individuals are of the same aspect. In length, too, it varies, from ten or twelve inches, to a foot and a half. The abdomen, or body part, is remarkably short, the tail forming one half, or even nearly two-thirds of the whole length, and gradually attenuating to its extremity, without, however, being so small and slender as in the switch snakes. The idea of its being blind is a mere prejudice; for it has large and sparkling eyes. Its erect attitude and nimble movements, alluded to by Lacépède, have not been observed by other naturalists who have studied its habits; on the contrary, except when darting on its prey, it was remarked to be more dull and sluggish than other serpents, so that the epithet *slow* is not inapplicable. The trivial name *fragilis* has a reference to the ease with which the tail may be broken asunder when abruptly struck, the fragments retaining their vitality for a considerable time after their separation from the rest of the animal. This slow-worm is of common occurrence throughout Europe, Africa, and the north of Asia. It is quite harmless, and is not easily induced to bite, except when it feeds, and then it seems to attack only living prey, particularly worms and insects, and it is devoured, in turn, by various birds, hedgehogs, snakes, frogs, and toads. Its natural haunts are hollow ways, woods, paths, rubbish, &c. In confinement, it will sometimes reject food for months together; but it will eat when rendered tame. The sexual union in this species is long and ardent, and takes place in spring, the female producing from six to twelve young, about a month after. The change of the skin, which sometimes proves a critical process, occurs in summer, and hybernation usually in the course of autumn. The common people, in some districts of France, foolishly believe, that this feeble and inoffensive reptile is more dangerous than the viper, and that the very sight of it presages misfortune. According to Dr Shaw, the *Blue-bellied Snake*, or *Aberdeen Slow-worm*, *Anguis Eryx*, Lin. is only a variety of the present species. Its colour and texture somewhat resemble bluish green glass; and this circumstance, combined with its fragility, might almost induce a spectator to fancy that it was composed of that brittle material. It is only the tail, however, that may be easily broke by a very gentle stroke of a switch. We need scarcely add, that the spontaneous re-union of the separate morsels is a vulgar fable.

The *Pytho Javanicus*, or *Great Snake of Java*, is of a greenish brown, with a purplish tinge, and yellow and black. According to Abel, it approaches more to a *coluber* than to a *boa*. It is often met with in the woody and swampy grounds of Java, but sometimes advances near the huts of the natives, and makes great havoc among the poultry, when no larger animals fall in its way; for it can destroy by the force of its muscular folds, deer, goats, wild hogs, and sheep, which it gorges entire. It frequently measures twenty feet in length; and both men and women are reported to have fallen victims to its rapacity. Of a male of this species, which was eighteen feet long, and eighteen inches in its largest circumference, the following particulars are related by Mr Abel, in his Narrative of a Journey in the Interior of China.

"This animal, although permitted, when I saw him at Batavia, to leave his cage, and go into an open space, was seldom disposed to avail himself of this liberty, and it was often necessary to drag him out, and to irritate him repeatedly, before he could be induced to move. He would then stretch himself to his greatest extent, and without throwing his body into any curve, glide so closely, slowly, and silently along the ground, and so exactly harmonized in colour with the soil over which he was passing, that, unless watched, he might easily have been overlooked. Whilst at full length he might be approached with safety, as he had not then the power of darting; but when he reared himself on his folds, and put his head into a vibratory motion, he had the greatest command of his powers, and exhibited the most threatening aspect. This attitude he usually assumed after he had been sometime from his cage, and all who were near him involuntarily drew back. A live duck being brought to him, he felt it for a moment with his forked tongue, and then, seizing it by the breast, endeavoured to wind his folds about its body, which being too small to suffer from their compression, he threw the weight of one of his folds upon its neck, and strangled it. When it was dead, he gradually withdrew himself, and taking it head foremost into his mouth sucked it down his throat. But a duck was only a mouthful to him; a goat being his usual meal. On board the Cæsar he swallowed two, which were given to him in his cage, at an interval of a month from each other. As soon as the goat was within his reach, he raised his head above his coils, and having contemplated his prey a few seconds, felt it with his tongue. The goat did not appear to be much alarmed, as he examined the snake closely, smelling him over with great deliberation. The snake having withdrawn his head a short distance, made a sudden dart at the throat of the goat, which received him on its horns, and obliged him for an instant to retreat. He then made a second dart, and seizing the goat by the leg, pulled it violently down, and insinuated his folds with momentary rapidity about its body, squeezing it at the same time with all the force he could bring to bear. But, even in this instance, the animal was too small to suffer their whole compressing effect, and he was obliged to destroy the goat much in the same manner as he had the duck, by throwing the weight of his body on its neck. The goat was eight minutes dying, but was so entirely overwhelmed by the power of the snake that it could not even struggle.

"The snake did not attempt to change his posture for some minutes after the goat was dead. At length he gradually slackened his folds, and then disengaged them one by one with great caution and slowness, as if to ascertain whether the goat retained any power of motion; and having entirely disentangled himself, prepared to swallow it, by placing himself opposite to its head, and feeling it with his mouth. While doing this, saliva flowed abundantly over his jaws, but he made no attempt to besmear his prey. In a few minutes he took its nose into his mouth, and endeavoured to draw the head after it: but this appeared to be no easy task. The dilatation of his throat seemed to begin with difficulty, as at least one-third of the time consumed in gorging the goat was in getting down the head and horns. These diverged at a considerable angle, and were four inches in length. Having conquered them, he grappled with the shoulders, which he was some time in mastering; but readily overcame the remainder of the body. In drawing the goat into his swallow, he appeared to work himself unto it, opening his mouth as wide as possible, and forcing it onwards. Whatever progress he thus made, was preserved by strong recurved teeth, which permitted the animal to pass down his throat, but prevented its regurgitation without his will. The act of swallowing was also much aided, I suspect, by the pressure of the air on the goat's body, as a deep inspiration accompanied every successive attempt to draw it down his throat. He was two hours and five minutes in gorging the whole animal.

"The appearance of the snake, when in the act of swallowing the shoulders of the goat, was very hideous. He seemed to be suffering strangulation. His cheeks, immensely dilated, appeared to be bursting, and his windpipe projected three inches beyond his jaws. The horns of the goat, which had advanced only a few inches down his swallow, protruded so much, that I expected them every instant to penetrate through the intervening membrane of the scales, while they separated from each other. After the goat was down, he scarcely moved from the posture he was in during his last act of deglutition, but fell into a semi-torpid state, from which no irritation could rouse him for several days. At this time he measured three feet in his greatest circumference, having doubled his ordinary diameter. The goat's body underwent no visible diminution of bulk or consistence by the action of the snake's folds, but seemed to pass down his throat in an entire state." This snake died in the course of its passage to England, in consequence of multitudes of worms having perforated the coats of the stomach.

OPHIOMANCY, an ancient method of divination from serpents, by means of which the duration of the siege of Troy was said to have been predicted by Calchas.

OPHIORHIZA, a genus of plants belonging to the Pentandria class, and of which there are two species. The root of the *O. Asiaticum*, or true Lignum Colubrinum, is in the East Indies employed as an antidote against the poison of the hooded serpent.

OPHIOXYLON *Serpentinum*, or scarlet-flowered Ophioxylum, a genus of plants belonging to the Polygamia class. There is but one species, which is indigenous to the East Indies.

OPHIR, a country from which, according to the sacred writings, Solomon received much gold in ships sent by him for the purpose. Regarding the situation of Ophir, very different ideas have, by different authors been maintained. Among the most probable opinions on the subject are those of the celebrated traveller Mr Bruce, and of Dr Doeg, author of "Letters on the Savage State." The former supposes that it may have been that kingdom of Africa, on the coast of Mosambique, now known by the name of Sofala; and the latter, that it was somewhere on the west coast of Africa.

OPHIRA, a genus of plants belonging to the Octandria class, and of which the O. *stricta*, which is a native of Africa, is the only species.

OPIE, John, professor of painting in the Royal academy. See Design.

OPHTHALMIA, a disease of the eyes, being an inflammation of the *tunica adnata* or *conjunctiva*, attended with swelling, redness, and pain. See Medicine.

OPIATES are medicines prepared with opium, and of a thicker consistence than syrup. Any medicine which has the property of promoting sleep is denominated an opiate.

OPIUM, the narcotic matter obtained from the milky juice of the white poppy, *papaver somniferum*, which is cultivated in India and different eastern countries. See Chemistry, and Materia Medica.

OPOPONAX, a most valuable gum resin, obtained from the *pastenaca opoponax*, a perennial plant which grows spontaneously in the south of Europe. It appears in pure grains, from the size of a pin's head to that of a pea, as well as in irregular lumps of a reddish-yellow colour, and it has a strong acrid taste; specific gravity 1.622. Opoponax brings from L.36, to L.40 per cwt.; the permanent duty being 2s. 3d. per pound.

OPORTO, a city of Portugal. See Entre Douro-é-Minho.

OPTATIVE, in grammar, the third mood in the conjunction of verbs, and which is employed to express great anxiety for any thing. Excepting in the Greek language, the optative is usually signified by prefixing to the subjunctive an adverb of wishing, as *utinam* in Latin, *plut a Dieu* in French, and *would to God* in English.

# OPTICS.

## INTRODUCTION.

Definition.

THAT department of Natural Philosophy which treats of the nature and mechanical properties of light, explains the laws by which it moves, and the changes which it undergoes, and illustrates and explains the phenomena of vision, is called OPTICS, from a Greek word which signifies *to see*.

The objects of this science are numerous and important. It makes us acquainted with many of the most interesting appearances of nature, and some of the most curious productions of art. It explains the admirable structure of the eye, and shews how that organ is adapted to the purposes of vision, and how its powers may be improved, and some of its imperfections remedied. It accounts for the production and variety of colours; for the form and regular tints of the rainbow; for the differences in the size and appearance of visible objects under various circumstances; and for many other natural phenomena, some of which have been regarded as ominous presages or magical delusions. To the same science we owe the invention or improvement of those ingenious contrivances by which the human eye is enabled to penetrate the distant regions of space, and behold worlds unknown to former ages, or unfold the hidden mysteries of nature, and contemplate the forms and motions of beings otherwise invisible. The study of optics is therefore one of the most interesting and useful in which the mind can engage. It is also highly entertaining. Many optical observations, and most of the experiments by which the principles of the science are illustrated, are calculated not only to enlighten the understanding but amuse the fancy, and afford ample and rational recreation for the hour of leisure.

Optics is related to several other departments of knowledge, either as it derives assistance from them or contributes to their elucidation. From anatomy it draws the description of that organic structure of the eye, the utility of which it is one of its objects to demonstrate. The relation between it and physiology is natural, as it derives from physiology those principles of vision which depend on the vital functions of the eye, and, in return, imparts those which it draws from the properties of light. To geometry and algebra it is indebted for the illustration of its terms and principles, and the demonstration of its propositions by diagrams and calculation; and to mechanics for the method of constructing and adjusting optical instruments and apparatus. It assists astronomy in computing the distance and magnitude of the planets, discovering the nature of their surface, and ascertaining the number and revolutions of their satellites, in enlarging the catalogue of the stars, and fixing their relative position. It extends the sphere, and facilitates the study of natural history, by introducing to our notice thousands of minute species, and enabling us to observe distinctly the intimate structure of those which, without its aid, would be very imperfectly known and distinguished.

The science has usually been divided into three principal branches: DIOPTRICS, which treats of the phenomena of transmitted light; CATOPTRICS, which treats of the phenomena of reflected light; and CHROMATICS, which treats of the phenomena of colours.

In the following pages is given such a popular view of the science of Optics as will, it is hoped, be intelligible to general readers, who have not made mathematics a principal object of attention. The subject is divided into three parts; in the first of which are laid down the principles of optics, illustrated by observations and experiments; in the second those principles are employed to explain the most important phenomena of nature; and the third contains the description and uses of the principal optical instruments.

## HISTORY.

History.

Many of the more striking phenomena of optics must have been known and studied at an early period. Of the reflexion of the rays of light, the earliest observers could not fail to acquire some knowledge. The surface of the water, no doubt, first served the purpose of a mirror; its effect was afterwards imitated by metallic mirrors: hence originated the discovery of the equality of the angles of incidence and reflexion. The invention and cultivation of optics cannot, with any decree of certainty, be traced to the remote ages of antiquity; but it is more than probable, that, at a period long before any of the speculations of the ancients were on record, mirrors were constructed of metal, and glass was discovered. In the books of Exodus and Job, mirrors of metal are expressly mentioned; and, according to Pliny, glass was accidentally discovered by the crew of a merchant vessel, which had entered the river Belus in Syria. (See GLASS MANUFACTURES.) After the manufacture of glass had made some progress, burning-lenses of glass were soon invented. Aristophanes, in his comedy of the Clouds, which was performed B. C. 424, introduces Strepsiades as making use of a burning-lens to cancel a bond, by melting the wax on which the writing was traced. Mention is also made by Pliny of glass-globes, which, being held to the sun, produced combustion; and Lactantius, A. D. 303, speaks of lighting a fire by holding a globe filled with water to the sun.

The celebrated Euclid, who flourished B. C. 300 years, composed a book on Optics, from which it appears that the ancients entertained vague, and, in many instances, erroneous notions concerning this branch of knowledge. In that work, which is published in the Oxford edition of his works, Euclid treats chiefly on catoptrics or reflected rays, the principal properties of which he endeavours to show in plane, convex, and concave surfaces, in his usual geometrical manner, commencing with that respecting the angles of incidence and reflexion, which he explains, and, in the concluding proposition, illustrating the effect of a concave *speculum* as a burning-glass when exposed to the rays of the sun.

If the surprising accounts of the inventions of Archimedes may be entirely credited, some remarkably powerful reflectors were constructed by that great philosopher. It is said that he wrote a treatise on burning mirrors, though it be not now extant; as also, concerning the appearance of a ring or circle under water: and, consequently, the ancients must have had some notion of the common phenomena of refraction. Indeed there are various sagacious though vague questions in the works of Aristotle, concerning optical appearances. This author held, that "it is the reflexion of light from the atmosphere which prevents total darkness after the sun sets, and in places where that luminary does not shine in the day-time." The general phenomena of rainbows, halos, and mock-suns, were observed by him with tolerable accuracy; and he was of opinion that the rainbow was occasioned by the reflexion of the sunbeams from the drops of rain, which produced an imperfect image of his disc.

Not only the more ordinary appearances of refraction, but likewise the production of colours by refracted light, were known to the ancients. Seneca observes, "that when the solar light shines through an angular piece of glass, it shews all the colours of the rainbow. These colours, however," he asserts, "are false, such as are seen in a pigeon's neck when it changes its position; and of the same nature," he adds, "is a speculum, which, without having any colour of its own, assumes that of any other body."

Of the magnifying power of glass-globes filled with water the ancients were well aware, though they knew nothing of the reason of this power; and it is said, that a glass-globe, filled with water, was used by the ancient engravers for the purpose of facilitating their work by magnifying the figures.

Claudius Ptolemy of Alexandria, who flourished about the middle of the second century, surpassed all the ancient writers on optics; but his book on the subject, which, from the accounts of different authors who had seen it, appears to have treated of astronomical refractions, has long been supposed to be lost. The earlier astronomers must have been much embarrassed in their observations, owing to their not being sensible that the intervals between stars appear less when near the horizon than at some distance above it. Of this circumstance Ptolemy seems not to have been ignorant, from the caution he gives in order to obviate the difficulty. This illustrious astronomer advances an hypothesis to account for the remarkably great apparent size of the sun and moon when near the horizon, which, by some modern philosophers, has been approved and adopted. "The mind," he says, "judges of the size of objects by means of a preconceived idea of their distance from us; and this distance is fancied to be greater when a number of objects are interposed between the eye and the body we are viewing, which is precisely the case when we see the heavenly bodies near the horizon." This enlarged appearance, however, is in the Almagest of Ptolemy ascribed to a refraction of the rays by vapours, which actually enlarge the angle under which the luminaries appear, just as the angle is enlarged by which an object is observed from under water.

The next author on the subject now under consideration was Alhazen, an Arabian philosopher, who flourished about the close of the eleventh century, and whose Treatise on Optics is justly deemed an important work for the time in which it was written. To this philosopher, who is said to have drawn all his conclusions from actual observations, the credit is entirely due of having clearly demonstrated the existence of a refractive power in the atmosphere, and of inducing astronomers to take it into their account. Alhazen treats of optical deceptions as produced by direct vision as well as by vision by refracted and reflected light. The first satisfactory account of the magnifying power of glasses was given in his writings, and probably suggested the invention of spectacles; for he states, that if an object be applied close to the base of the larger segment of a sphere of glass, it will appear magnified. By refuting the old established opinions respecting vision, and proving that the rays which produce vision come from the object to the eye, a great step in the science was evidently made by this philosopher.

Among Europeans, the first writer on optics of any consequence was Vitellio, a native of Poland, who, in the year 1270, drew up a voluminous work, comprising all that was important in the writings of the Arabian philosopher Alhazen, whose disciple he acknowledged himself to be, after having vainly endeavoured to deny that he had any knowledge of his treatise. Vitellio gave a table of the results of his own experiments on the refractive powers of air, water, and glass, corresponding to different angles of incidence. He observes, that light is lost wherever it suffers refraction or reflexion, and the objects always appear less luminous. He ascribes the twinkling of the stars to the motion of the air in which the light is refracted, shews that refraction is necessary as well as reflexion to form the rainbow, and makes some ingenious attempts to illustrate refraction, and to ascertain its law. Cotemporary with Vitellio was the celebrated Roger Bacon, who, by his extraordinary attainments in natural philosophy, astonished the age in which he lived, and still retains a high reputation among the learned. This philopher treated largely on optics in his *Opus Majus*; but he does not seem to have added any thing remarkably important to the improvements of Alhazen and Vitellio. The invention of spectacles and telescopes was anticipated by him in very striking language. He says, that, if an object be applied close to the base of the larger segment of a sphere of glass, it will appear magnified; and in treating of the appearance of an object through a globe, he affirms that he was the first who observed the refraction of rays into it. Indeed, several respectable writers concur in regarding him as the inventor of spectacles and telescopes; and it is an undoubted fact, that the credit of inventions has been frequently awarded on less decided evidence than that upon which the telescope and microscope are attributed to Bacon. Dr Smith has endeavoured to controvert the opinion that Roger Bacon was the inventor of telescopes and spectacles; but it cannot be questioned, that he at all events prepared the way for their immediate introduction. About the time of his death, spectacles were probably well known. Alexander de Spina, an Italian friar, who died at Pisa in 1313, is said to have constructed a pair of spectacles for himself, in consequence of having seen a pair in the possession of another person; and Mushenbroek affirms, that it is inscribed on the tomb of Salvinus Armatus, a nobleman of Florence, who died in 1317, that he was the inventor of spectacles.

About the commencement of the sixteenth century, the science of optics began to make considerable progress. Maurolycus, a teacher of mathematics at Messina, who was born 1494, and died 1575, published his *Theoremata de Lumine et Umbra*, and his *Diaphonorum Partes ceu Libri Tres*,—two works evincing both genius and industry on the part of the author, and containing some interesting speculations on the measure and comparison of the effects of light, on the different degrees of brightness which an opaque object receives from a luminous one, according as it is more or less distant, &c. In his *de Lumine et Umbra* he demonstrates the phenomena of vision, and shews why some persons are long-sighted and others short-sighted, and why the former are relieved by convex and the latter by concave glasses. Maurolycus had the merit of explaining satisfactorily the problem which had baffled the researches of all optical writers from the time of Aristotle. This is, that when the solar rays shine through an aperture of any shape, the figure of the aperture invariably appears round; and, in like manner, when the sun has the form of a crescent in the time of an eclipse, every aperture through which his rays pass is of a crescent form. The inquiries of this indefatigable philosopher were not on all occasions crowned with success; yet he unquestionably laid his successors under some obligations, by sparing them the trouble of many laborious and futile attempts.

John Baptista Porta, the celebrated Neapolitan philosopher, was cotemporary with Maurolycus. Having instituted, at his own house, what he called the *Academy of Secrets*, which consisted of all the ingenious persons in Naples, each of whom was obliged to contribute something useful, and not generally known, he was enabled, at the early age of 15, to produce his *Magia Naturalis*, which was first published in 1560. This work comprised every thing remarkable that was known at the time, and contains a description of the camera obscura. In the seventeenth chapter, he says, that "if a small hole be made in the window-shutter of a room, from which the light is everywhere else completely excluded, we shall see the external objects depicted on the opposite wall, or on a piece of paper, in their natural colours;" and he adds, that "by placing a small convex lens at the aperture, the objects will appear sufficiently distinct to be instantaneously recognized." He moreover suggests, that, in order to make the images formed on the camera obscura erect, they must be viewed upon a convex mirror, properly adapted to the convex glass, and kept at a due distance from the aperture. By his experiments on this optical instrument, he was led to the conviction that light is a substance by the reception of which, into the eye, vision is accomplished. This was a great discovery, which superseded the notion formerly entertained, that vision was dependent upon *visual* rays proceeding from the eye. Baptista Porta arrived very near at an illustration of the phenomena of vision, but had not the happiness to effect it completely. He very properly considered the eye itself as a camera obscura, the pupil being analogous to the hole in the window-shutter; but was mistaken in supposing that the crystalline lens corresponds to the ground which receives the image. It appears that the discovery of the contraction and dilatation of the pupil was made by Achillinus, in 1522, and by father Paul of Venice at a later period.

About that time, the attention of philosophers was particularly occupied with the subject of the rainbow, the true theory of which was first suggested by Antonio De Dominis, archbishop of Spalatro, in a treatise *De Radiis Visus et Lucis*, published in 1611, by Bartolus. Notwithstanding the vague and inaccurate reasonings of De Dominis, it must be acknowledged, that, while his explanation of the interior bow is altogether erroneous, his views concerning the general phenomena of the exterior bow were calculated to lead any other philosopher of superior attainments in the science of optics to a proper explanation.

As the optical instruments, on which the construction of telescopes depends, were evidently known to the ancient geometricians, it is matter of surprise that the world was so long without that excellent and highly useful invention. There is no doubt, however, that the telescope was long known as an experiment before it was introduced as an instrument. So gradual were the steps by which the telescope was brought to perfection, that no well-founded claim to the invention has been yet made out, though numerous competitors for that honour have appeared. At the beginning of his Dioptrics, published in 1637, Des Cartes asserts, that, thirty years before, the telescope was very accidentally invented by James Metius, a citizen of Alkmaer, while he was amusing himself with mirrors and burning-glasses. The story of this great discovery being made by John Lipperheim, a spectacle-maker of Middleburg, in Zealand, or rather by his children, is very little credited. But the claims of Zacharias Jansen, another maker of spectacles at the same place, are urged by Borelli, in his book *De Vero Telescopii Inventore*, in so decided a manner as to leave almost no doubt on the subject. He states, that this ingenious mechanic, who was a diligent enquirer into nature, was fortunate in hitting upon the construction, while engaged in trying what uses could be made of lenses. It appears that, about the year 1610, Jansen contrived a telescope, with which he immediately ran to Prince Maurice, who, conceiving that it might be of use to him in his wars, desired it to be kept a secret. But the invention unavoidably soon became known, and John Lapprey of Middleburg (who was for a time reputed the inventor) began to make and sell telescopes. The honour of this admirable invention is, by some, assigned to Galileo, who, in his *Nacius Siderius*, which appeared in 1610, states as follows: "Near ten months ago, it was reported that a certain Dutchman had made a perspective, through which very distant objects appeared distinct, as if they were near. Several experiments were reported of this wonderful effect, which some believed and others denied; but having it confirmed to me a few days after, by a letter from the noble James Badovere at Paris, I applied myself to consider the reason of it, and by what means I could contrive a like instrument, which I attained to soon after, by the doctrine of refraction. And, first, I prepared a leaden tube, in whose extremities I fitted two spectacle-glasses, both of them plain on one side, and on the other side one of them spherically convex, and the other concave. Then applying my eye to the concave, I saw objects appear pretty large, and pretty near me. They appeared three times nearer, and nine times larger (in surface) than to the naked eye; and, soon after, I made another which represented objects above sixty times larger; and at last, having spared no labour nor expense, I made an instrument so excellent as to shew things almost 1000 times larger, and above 30 times nearer to the naked eye." Galileo had thus great merit with respect to the telescope; but an important service to science still remained to be performed, which was to explain the *rationale* of the instrument. This was accomplished by Kepler, who is celebrated in the History of Optics chiefly for his suggestion of an astronomical telescope, a suggestion which was first put in practice by Scheiner. The common refracting telescope was materially improved by Father Rheita.

To the phenomena of light and vision, great attention was paid by Kepler, who availed himself of the discoveries made by Maurolycus, as well as of Porta's comparison of the camera obscura with the eye. That active philosopher succeeded in tracing and explaining the course of the rays passing from a luminary through the several humours and other parts of the eye; but he was long at a loss to assign any satisfactory reason why objects, since they are depicted on the bottom of the eye in an inverted position, should, notwithstanding, appear to the observer in their natural situation,—and, indeed, this is a difficulty which, in the opinion of some, still remains unresolved. He was the first who demonstrated that the degree of refraction suffered by light, in passing through lenses, corresponds to the diameter of the circle of which the convexity or concavity is the portion of an arch.

The investigation of Des Cartes added, in a high degree, to the advancement of optical knowledge; but the lustre of this philosopher's name was impaired by the selfish appropriation of the improvements introduced into the science by De Dominis and Snellius, whose names he never even mentions in his Dioptrics. The credit of discovering the true law of refraction is unquestionably due to Willebrord Snellius, professor of mathematics at Leyden, who died in 1626, at the early age of 35, and whose manuscript on the subject fell into the hands of Professor Hortensius. According to Vossius, the heirs of this professor freely communicated to Des Cartes his papers, among which was that of Snellius' work; and this testimony is, in some measure, confirmed by Huygens. On the principle of De Dominis and Kepler, the nature of vision, and the phenomena of the rainbow, were admirably illustrated by Des Cartes.

Some valuable facts were added to the subject of vision by Scheiner. By taking the eye of an animal and cutting away the coats of the back part, and presenting different objects before it, he displayed their images distinctly painted on the naked retina. This experiment, which was exhibited by him at Rome in 1625, established the fact that vision depends upon the images of external objects being depicted upon the retina.

Among the discoveries of this period was that of double refraction, which was made by Erasmus Bartholinus, an account of which appeared in No. 67. of the *Phil. Trans.*; see also the *Edin. Phil. Jour.* Vol. I.

Several treatises connected with optics were drawn up at different times by Huygens, none of which, however, appeared till after his death, which happened in 1695. He, in 1678, communicated a treatise on light to the academy of Sciences at Paris, of which he was a member. This work, the purpose of which was to explain physically and mathematically the laws of the motion of light, whether transmitted in a right line or reflected or refracted, comprises numerous investigations, among which it is demonstrated that a globule of light transversing a medium, composed of strata of different densities, must describe a curve, the fundamental property of which the author shews how to determine in all cases. The *Dioptrics* of Huygens, which was much admired by Newton himself, contains an ample account of the properties of lenses of all forms. In his *Commentarii de formandis poliendisque vitris ad Telescopia*, he unfolds his method of constructing telescopes. Along with this work he published his *Dissertatio de Coronis et Parheliis*, wherein he, with great ingenuity, endeavours to give the theory of these interesting phenomena.

About the middle of the 17th century, Olaus Roemer, the Danish astronomer, made the grand discovery of the successive propagation of light, and the velocity with which it moves in absolute space.

The celebrated James Gregory made known his invention of the reflecting telescope in 1663, by the publication of his *Optica Promota*. This ingenious mathematician, who died in 1675, at the early age of 37, enriched the science not only with the invention of the reflecting telescope, but also the discovery of the law of refraction in its most perfect form.

Among the optical writers of this period was Francis Maria Grimaldi, an Italian Jesuit, who assiduously cultivated the physical sciences. The elongation of the solar image by prismatic refraction was first observed by him, besides which, he made some discoveries on the inflection or diffraction of light.

To the discovery of the inflection of light, Dr Hooke laid claim, though he did not communicate his observations to the Royal society till six years after the publication of Grimaldi's *Physico-mathesis de Lumine.* In a paper, however, presented by our ingenious countryman, in 1675, to the same learned body, he deduces a number of conclusions from his experiments which have occupied the attention of subsequent philosophers.—1. There is deflection of light differing both from reflexion and refraction, and seeming to depend on the unequal density of the constituent parts of the ray, whereby the light is dispersed from the place of condensation, and rarefied or gradually diverged into a quadrant. 2. This deflection is made towards the superficies of the opaque body perpendicularly. 3. Those parts of the diverged radiation which are deflected by the greatest angle from the straight or direct radiation are the faintest, and those that are deflected by the least angles are the strongest. 4. Rays cutting each other in one common foramen, do not make two angles at the vertex equal. 5. Colours may be made without refraction. 6. The diameter of the sun cannot be taken with common sights. 7. The same rays of light falling upon the same point of an object will turn into all sorts of colours by the various inclination of the object. 8. Colours begin to appear when two pulses of light are blended so well and so near together that the sense takes them for one.

The splendour of Sir Isaac Newton's discoveries in a great measure eclipsed the merit of all the writers who had preceded him. He not only repeated the experiments of Grimaldi and Dr Hooke, but carried them much farther than they had thought of. From the queries subjoined to the first part of the third book of his *Optics*, he seems to regard the phenomena of inflexion as produced by the action of bodies on the passing light, and to consider the colours of the fringes as arising from the different flexibilities of the differently coloured rays, and the three fringes as arising from three bendings resembling the motion of an eel. To the illustrious Newton was reserved the discovery of the causes of colours. He applied his principles successfully to the explanation of most of the phenomena of nature where light and colour are concerned; and the greater part of what is known on these subjects was unfolded by his admirable experiments. He found, that the refractive powers of substances are generally proportionate to their densities, except when they contain inflammable or oily particles. Observing that the refractive power of the diamond is considerably greater than that of most other substances of equal density, he happily concluded that it is a combustible body, a fact which succeeding discoveries have irrefragably proved. See Newton.

Since the time of Sir Isaac Newton, the science of optics has been greatly advanced, and England has acquired the credit of the discoveries of the aberration of light, and the invention of the acromatic telescope. The improved method of constructing reflecting telescopes, to which, after Sir Isaac, many able philosophers and artists have contributed, has led to splendid discoveries; and the high degree of perfection to which the refracting telescope was brought by Mr John Dolland, in conjunction with his son Peter, has proved of very great advantage to scientific men. The triple object-glass wherein the lens of flint-glass was placed between the two lenses of crown-glass, in order to obtain a better correction of the spherical aberration, was first suggested by Mr Peter Dolland, and has been long admired.

Our limits will not admit of giving an account of all the writers who have endeavoured to promote optical knowledge. Among the distinguished names that adorn the science are those of Euler, Clairaut, D'Alembert, Boscovich, Bouguer, Lambert, Porterfield, Jurin, Delaval, Dr Herschel, Blair, Young, Wollaston, Malus, Arago, Biot, Seebeck, Fresnel, Fraunhofer, Berard, Morichini, and Mr Herschel.

Among the latest and most successful cultivators of the science must be particularly noticed Dr David Brewster, who has not only added much to our knowledge respecting the properties of light, but has materially improved some optical instruments, and contrived others, especially the kaleidoscope, which, though chiefly an object of amusement, might be rendered useful in some of the ornamental arts.

The reader who is desirous of further information regarding the history of optics, may consult the following works: Montucla's *Histoire des Mathematiques*, 4 vols.; Dr Priestley's *History and Present State of Discoveries relating to Vision, Light, and Colours*, 2 vols.; Bossut's *Hist. Gen. des Mathematiques*, 2 vols. 8vo.; Smith's *Complete System of Optics*, 2 vols.; Borelli, *De Vero Telescopii Inventore*; Kircher, *Ars Magna Lucis et Umbræ*; Ricorde's *Pathway to Knowledge*; L. Digge's *Pantometria*; Des Cartes *Dioptrica*, in his *Opusc.* tom. II.; Vossius, *De Natura Lucis*; Zuchii, *Optica Philosophica*; *Philosophical Magazine*, Vols. XVIII. and XIX.; Newton's *Optics* and *Lectiones Opticae*; Marriotte, *Œuvres*, 2 vols.; Le Cats, *Traité des Sens*; Bouguer *Traite d' Optique*; Lambert's *Photometria*; and Dr Thomas Young's *Lectures on Natural Philosophy.*

## PART I. PRINCIPLES OF OPTICS.

This part of the science includes not only the three departments into which optics has been divided, as stated in the introduction, but also the consideration of the nature and general properties of light; and some remarks on those changes of it, called inflexion, abberation, and polarisation.

### Chap I. Of the Nature and General Properties of Light.

The precise nature of light is still a matter of speculation and dispute. Two opinions respecting it divide the philosophic world. One is, that light is a

Of Light.

peculiar kind of matter different from heat, though frequently combined with it, and extremely subtile,—proceeding directly from the sun and other luminous bodies, and by reflexion from other visible objects. According to the second opinion, light is the effect of the undulation of a subtile ether, making an impression on the eye as sound does on the ear. There are objections to both these opinions; but, on the whole, the first seems the most plausible, and best explains the phenomena. It is presumed, then, that light is the most subtile of all known substances, and that it is continually emitted by the sun and fixed stars, and reflected from the moon and planets.

The general mechanical *properties* of light are these:—1. It proceeds from every point of a visible object, in straight lines. This property is evident, from the facts, that we see every point of the surface of a luminous or visible object opposite to us, in whatever direction we look at it, and that we cannot see an object through a bent tube. The smallest perceptible line of light is called a *ray*; and when several rays proceed from the same point, they form a *pencil* or *beam* of light, according as they spread or continue in a condensed state in their progress. Rays of light are said to be *parallel* when they continue at the same distance from each other; they are said to *diverge* when they spread farther and farther from each other, as they recede from the luminous or visible point to the place of observation, and to *converge* when they draw nearer to each other as they reach the place of observation.—Thus in the Plate, Fig. 1. suppose *a b* to be the place of observation, and P the visible point, the rays proceeding from P to *a b* are diverging rays. If, again, *a b* be a visible object, and *p* the place of observation, the rays proceeding from *a b* to *p* are converging rays.

2. Light consists of distinct particles, which are extremely minute. That the particles are distinct is evident, because a ray of light may be intercepted in any part of its course; and the minuteness of the particles is proved by the facility with which they pass through the smallest pin-hole without disorder or confusion.

3. The velocity with which light moves, appears to be greater than that of any other known substance. This velocity is computed to be at the rate of 195,000 miles in a second, and it takes only seven minutes to travel from the sun to the earth.

4. The density of light passing through a *medium* which offers no resistance to its progress, diminishes in a certain proportion according to the distance from the visible point. Any space or substance capable of transmitting the rays of light, such as air, water, and all clear liquids, glass, rock-crystal, and all clear stones, is called a medium, and light passes through them with greater or less ease in proportion as they are more or less transparent and colourless. In proportion as they are opaque or deeply coloured, they resist or absorb the rays of light. The density of light depends on the number of particles in the same space; and it is natural to conclude that its density is greatest at the point from which it proceeds. Accordingly, we find that an object is more visible and distinct as we approach it nearer, and becomes more obscure as we recede from it. This is owing to the greater or less density of the light proceeding from the object. It has been proved that the density of light, in a non-resisting medium, diminishes in proportion to the square of the distance from the luminous or visible object; that is, supposing the light to be of a certain density at any particular distance, it will be four times less dense at double the distance, nine times less dense at three times the distance, and so on for any greater distance.

Refracted Light.

5. The *momentum* of light is very inconsiderable. It has been shewn, under MECHANICS, that the *momentum* of a body in motion, or the force with which it strikes an opposing object, is estimated by the product of its quantity of matter multiplied by its velocity. Now, considering the amazing velocity of light, it might be concluded that its *momentum* should be at least very perceptible; and this would be the case, were not the particles of light inconceivably minute. Were they even of such a size that 2,000,000 of them occupied the space of an ordinary grain of sand, they would strike against our bodies with as much force as sand projected from the mouth of a cannon, as they move with a velocity 2,000,000 times greater than that of a cannon ball. Nothing can give us a more amazing idea of the extreme minuteness of the particles of light than this consideration. Yet that light has *momentum*, like other moving matter, is supposed to be proved by the experiment of throwing its concentrated rays on a nicely balanced thin plate, and thus setting the plate in motion.

## CHAP. II. OF THE PHENOMENA OF REFRACTED LIGHT.

As long as a ray of light continues to move through a medium of the same density, as glass or water, it undergoes no change in its direction; and when it passes out of one medium, as air, into another of a a different density, as water or glass, it proceeds in the same straight line, provided it enter the other medium in a direction perpendicular to its surface. But if it enter the medium in a slanting direction, so as to make an angle with a line perpendicular to the surface, its direction is altered, so that it approaches near the perpendicular, or recedes farther from it, making with it a less or greater angle, according as the new medium is denser or rarer than that from which it came. This property is called the *refrangibility* of light; and the ray thus *bent* out of the straight line is said to suffer *refraction*, or to be refracted. Thus, in Fig. 2. if *a b* represent the bounding surface of two media, as air above and water below, and A B be a ray of light passing perpendicularly from the one to the other, it will continue to move in a straight line to C; but if another ray, D B, enter the denser medium at B, it will not proceed in the direction B *e*, but will turn into one nearer A C, as B C, making the angle E B C less than the angle D B A. Again, if the ray E B, coming from a denser medium, and obliquely entering a rarer at B, it will take a course, as B D, diverging from C A, and making with it a greater angle.

This refraction of oblique rays may be illustrated by two simple experiments. If a straight stick be held in a bason of water in a perpendicular position, as A C, it will continue to appear straight; but if it be held in an oblique position, as D *e*, it will appear as if bent from B to E. Again, suppose the lower half of the circle at Fig. 2. to represent a bason at first empty, and that some object, as a shilling, be placed in it, as at E; let the observer retire from the bason till he just loses sight of the object, as to the point D; then let water be poured into the bason, and the object will be again seen, as if risen to *e*, though it retain its original position at E.

The same figure enables us to explain some other terms, which must be understood before proceeding. The angle formed by an *incident* ray and a perpendicular to the point at which it enters another medium, is called the *angle of incidence*, and the angle formed by the refracted ray and the same perpendicular is called the *angle of refraction*. In Fig. 2. where the upper medium is supposed to be rarer and the lower denser, D B A is the angle of incidence for the ray D B entering the denser medium, and E B C is the angle of refraction; but for the ray E B passing from a denser to a rarer medium, those angles are reversed, and exchange names,—E B *e* is called the angle of deviation. The degree of refraction is estimated by comparing the *sines* of the angles. Thus for the incident ray D B, D *d* is the sine of the angle of incidence, and E *c* that of the angle of refraction, while for the incident ray E B those sines are reversed. Now these sines are found to bear a certain proportion to each other, according to the nature of the media. In the case of air and water, when a ray passes from the former to the latter, the sine of incidence is to that of refraction nearly as 4 to 3, and in the reversed case they are as 3 to 4.

The refraction which light suffers in passing through any medium is in proportion to the density and combustible nature of the medium. The refracting power of water is greater than that of air, but that of oil is still greater, because, though oil is less dense than water, the former is combustible.—Glass refracts more than either from its density; and diamond possesses a high refracting power, partly from its great density and partly from its being combustible. See CHEMISTRY. On comparing air, crown-glass, and diamond together, with respect to the refracting power of the two latter on rays entering them from air, it is found that, with respect to glass, the sine of incidence to that of refraction is as 3 to 2, while with diamond it is as 1 to $\frac{2}{5}$.

The refracting power of different media is modified by certain other circumstances. In all it is supposed to be owing to the attraction of the matter composing the medium for the light passing through it, and is of course greater in proportion to the quantity of matter in the medium, or, in other words, its density. This attraction appears to accelerate the light, so that it moves more directly through a dense than through a rare medium, provided this be transparent. The attraction is so great, that it affects the light before it touches the surface of the dense medium, and the refraction begins before the ray, as D B, reaches the point of contact B. It is evident that all rays proceeding from a rarer to a denser medium must be refracted, however great the angle of incidence; but it is different with rays passing from a denser to a rarer medium. If these rays strike the surface of the rarer medium at such an inclination that the sign of the angle of refraction would be greater than the radius, the ray will not enter the rarer medium, or will suffer no refraction, but will return into the denser medium. To understand this, it must be remarked, that the greater the angle of incidence, the greater in proportion will be the angle of refraction. Now, referring to Fig. 2. it is easy to conceive that a ray of light may proceed from the denser medium, so far beyond *e*, that after refraction it will coincide with *a* B the radius, and the object beyond *e* will be just visible at *a*; but if the angle of incidence be still increased, the angle of refraction will be increased in proportion, the refracted ray will fall below *a* B, and the object will be no longer visible in the rarer medium.

Among the most interesting phenomena of refraction, are the changes in the direction of the rays of light in passing through transparent media. The effect of these media differs according to the form of their bounding surfaces. Observations and experiments on this subject are most conveniently made with pieces of polished flint-glass, cut and ground into particular forms with respect to their transmitting surfaces, and called *plates, lenses*, and *prisms*.—Sections of the principal refracting glasses are represented at Fig. 3. arranged along a middle line passing through their centres, and called the axis. A represents a plate, or plane glass, bounded by plane or flat surfaces parallel to each other. The next six are lenses, and of these B is a *plano-convex*, having one of its surfaces flat and the other convex. C is a double convex lens, because both its surfaces are convex. D is a *plano-concave* lens, with one surface flat and the opposite concave. E is a double concave lens, with both surfaces concave. F is a convexo-concave lens, having one of its surfaces convex and the other concave. G is a lens of a peculiar figure, having one side plane and the other convex, but cut into several angular planes or *facets*. H is the section of a triangular prism. Of these eight figures, A and H are bounded by plane surfaces, B, C, D, E, and F either wholly or partially by curved surfaces, and G may be said to partake of the nature of both. The effects of each on the rays transmitted by them require a separate consideration.

When incident rays of light pass through a plane refracting medium into one of the same density with that from which they emerged, they proceed, after refraction, in a direction parallel to that in which they fell on the refracting medium. It has already been stated, that the rays of light are sometimes parallel. This is not strictly true, as they are always, when proceeding naturally from visible objects, diverging; but when the object is at a great distance from the place of observation, which is the case with the sun, their divergence is so small in proportion to the distance, that they may be considered parallel without any material error. Keeping this in mind, suppose two parallel rays to fall perpendicularly on

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PLATE. 143.

*Fig. 1.*

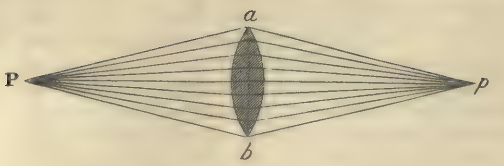


*Fig. 2.*

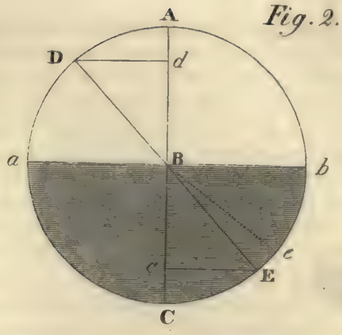


*Fig. 3.*

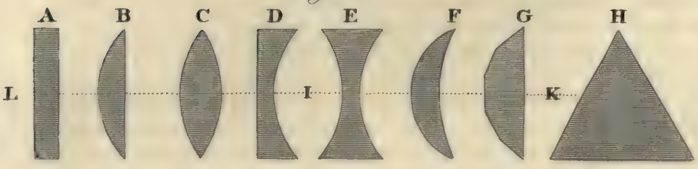


*Fig. 4.*

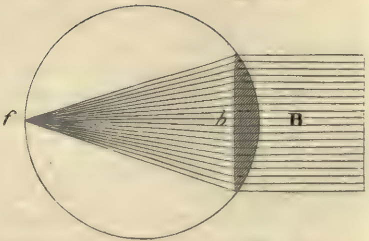


*Fig. 5.*

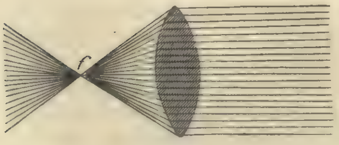


*Fig. 6.*

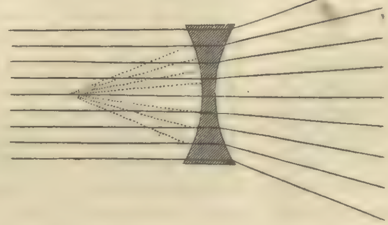


*Fig. 7.*

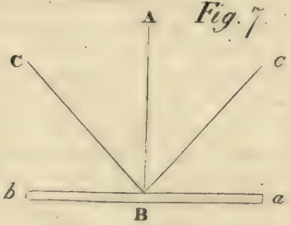


*Fig. 8.*

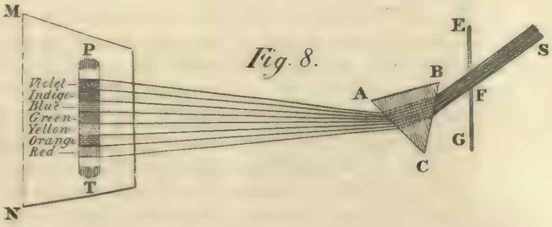
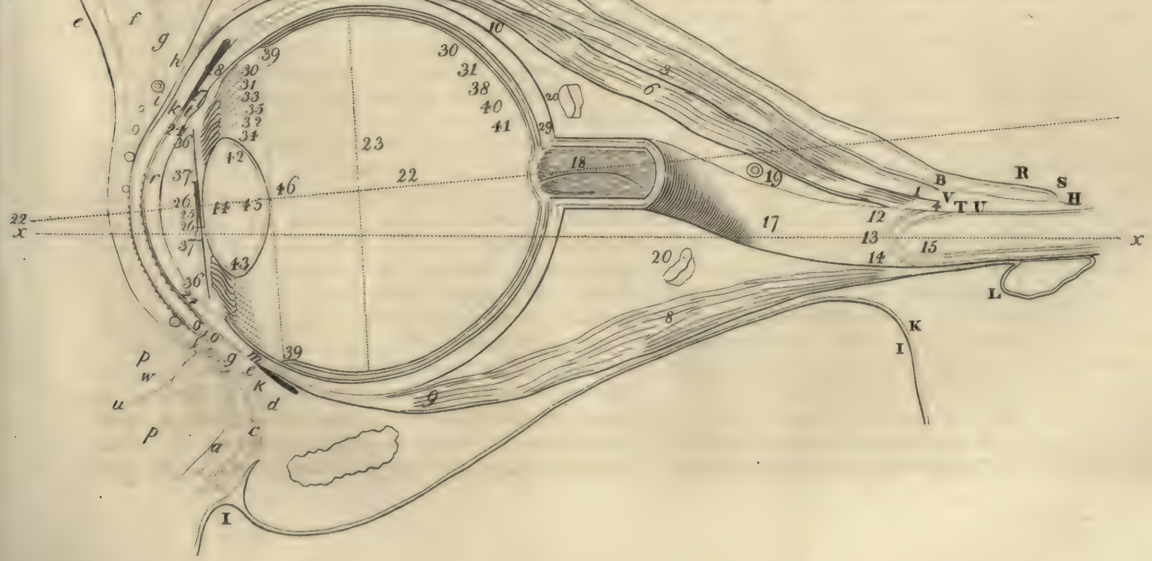


*Fig. 9.*



F. Mitchell sculpt.

one surface of a plane glass,—it is evident, from what has been already said, that they will proceed both through the glass and the medium on the other side in straight lines, and will of course continue parallel. If they strike the first surface of the glass obliquely, they will both be refracted in an equal degree in passing through the glass; and when emerging from the opposite surface they will again be refracted in an opposite direction; so that the angles of this new refraction will be equal to the original angles of incidence, that is, their direction will be parallel to that in which they first struck the glass. The same effect takes place with rays that are not parallel, and may easily be conceived without a figure. Hence it appears, that when we view objects through a common plate of glass, as the panes of a window, we see those which are directly opposite to us unaltered, both as to place and figure, but those which are viewed obliquely, though not altered in figure, are not seen exactly in their true place, but a little to one side of it. It may be here remarked, that as some light is always lost by refraction, for reasons to be afterwards given, objects are not seen so distinctly through panes of the cleanest and clearest glass as in the open air. The effect of lenses, such as B and C, Fig. 3. which have one surface or both convex, is to cause the rays which pass through them to converge; but this effect takes place at different distances behind the lens, according as it is plano-convex, or double convex. The former must be regarded as a portion of a sphere (see Fig. 4.) and when parallel rays fall upon it, all but that ray which coincides with the axis, as B, *b*, *f*, suffer refraction in passing through the glass, because they are oblique or incident with respect to the convex surface, and the more so according as they are more distant from the axis. It is evident, therefore, that they must form larger and larger angles of refraction, and that the subsequent refraction which they experience in emerging from the plane surface is not sufficient to restore their parallelism, but they will continue to converge till they meet in a point, as *f*. This point is called the focus, and is at a distance equal to the diameter of the sphere of which the plano-convex lens forms a part, or, as appears from the figure, in the opposite circumference of the circle of convexity. It is different with respect to a double-convex lens, (see Fig. 5.) which may be considered as two spherical portions, such as Fig. 4. united by their plane surfaces. Of course, the convergency of the rays is doubled, and will take place at one half the distance, or the focus will be in the centre of the circle of convexity. If there be no obstacle to oppose the passage of the rays, they will there cross each other, and diverge. These effects may be illustrated experimentally, by holding a convex lens close to a small hole in a closed window-shutter, and receiving the rays that pass through it on a piece of white paper. If the paper be held exactly at the focal distance, a small lucid point will be observed where the rays converge; and as the paper is removed farther back, the point will expand into a circle larger in proportion to the distance, shewing that the rays diverge after passing the focus.

When diverging rays pass through a convex lens, they are affected differently according to the distance of the lens from the visible object. This is well illustrated with a lighted candle. If the lens be held at its focal distance from the candle, the rays of the latter, received on a sheet of paper, will appear parallel, as appears by their exhibiting a luminous circle of the form and size of the lens. If it be held farther from the candle, a lucid spot will be seen on the paper exhibiting within it a miniature picture of the flame inverted, which shews that the rays from the candle have converged, and, after crossing each other, struck the paper at points opposite to those from which they proceeded.

Another effect of convex lenses is to make minute objects appear larger when the glass is held at a proper distance between the eye and the object. If the distance be a little greater than the focal distance the magnified object will be distinct; and as the distance of the glass from the object increases, the latter will appear still larger, but less distinct, owing to the great divergence of the rays. From this property, those lenses are called magnifying glasses. When such lenses are exposed to the bright rays of the sun, and an inflammable substance is held in the focus, that substance is set on fire or made to smoke; so that, under favourable circumstances, they act as burning-glasses.

The effects of lenses which have one or both of their surfaces concave, are directly the reverse of those of convex lenses. Parallel rays received by one surface, are rendered divergent when emerging from the other; diverging rays are made to undergo still more; and converging rays are made to converge less, so as sometimes to be parallel. These effects are illustrated by Fig. 6. in which the rays on the left side of the lens are partly parallel and partly diverging, and those on the right side are more diverging than the former, and each set may be considered incident or refracted, according as they fall first on the one side or the other. It is evident that the diverging power of a concave lens must be less or greater according as the lens is plano-concave or doubly concave. Many of the refracted rays emerging from these lenses are dispersed so as not to enter the eye of the observer. Hence an object viewed through them appears smaller, and consequently at a greater distance than natural, because fewer rays proceed from it to the eye. See *Vision* under Part III. Concave lenses have properly no focus behind them in which rays can be collected into a lucid point, as will appear by holding such a lens between a luminous body and a piece of paper. But they have what is called a *virtual focus* on their anterior side, and its distance from the concave surface corresponds, as in convex lenses, to the diameter or radius of the sphere of concavity, according as the lens is singly or doubly concave.

Lenses which have one surface convex and the other concave, are usually distinguished by the general name *meniscus*. They are of three kinds. In the simple meniscus, the convexity and concavity are equal, or their surfaces, though curved, are parallel to each other, so that their effect on the rays of light is similar to that of a plane glass; the convergence produced by the convex surface being exactly counterbalanced by the divergence from the concave. A common watch-glass is a meniscus of this kind, and evidently neither magnifies nor diminishes. The other two kinds are called *periscopic*, and differ in their effects according as the convexity is greater or less than the concavity. F, Fig. 3. is a glass of the former kind, which causes the rays to converge, and magnifies objects. The other kind is called a concavo-convex glass, because the concavity exceeds the convexity. It acts as a concave lens in diverging the rays and diminishing objects.

The glass G, Fig. 3. whose convex surface is cut into plane facets, acts in a peculiar manner. It causes the rays of light to converge behind it, but in separate pencils refracted by each facet; so that when an object is viewed through such a glass, it appears multiplied as many times as there are facets. The glass is therefore called a multiplying-glass.

*Prisms* are solid pieces of glass, bounded by flat surfaces, which, in the common form, are inclined to each other at angles; so that a verticle section forms a triangle, as at H. Fig. 3. The refraction of the rays of light in passing through a prism, will most properly be considered in a subsequent chapter, as it involves the consideration of colours. Here it will be sufficient to remark, that, when parallel rays, as a beam of light from the sun, fall on one surface of a prism, they are refracted from the opposite part so as to form an oblong image, bounded at the extremities by curves, and at the sides by straight lines, and differing in length according to the position of the prism or the part presented towards the luminous object.

The practical use of lenses, and the methods of finding their *foci*, belong to Part III.

The laws of refraction in particular cases can be explained only by mathematical calculation; and for that explanation the reader is referred to the mathematical writers on optics, especially Smith, Emerson, and Young. The general laws may be reduced to two; one relating to refraction *within* the refracting medium, and the other to refraction *beyond* it. The first is, that, when a ray of light passes from one refracting medium into another, the sine of the angle of incidence is to the sine of the angle of refraction in a constant ratio. The second general law is, that when a ray of light passes from a given point in one medium to a given point in another, it is refracted at the surface that separates the true media, so that it takes up the least possible time in its passage.

The general theory of refraction is still imperfect; but supposing light to be a material substance, its refraction is, as has been already stated, attributed to the attraction of the matter composing the refracting medium for the particles of light. This attraction is evidently of a different nature from that of gravitation, as it is exerted in a degree far superior to gravitation, and is considerably stronger at the surface than at the centre of the refracting body.

## CHAP. III. ON THE PHENOMENA OF REFLECTED LIGHT.

In the preceding chapter, transparent bodies or media have been considered only as they refract the rays of light; but this is not their only effect. All transparent bodies which have polished surfaces, and all opaque bodies under similar circumstances, have a tendency to reflect or throw back more or less of the light that falls upon them; but this effect is more remarkable in the latter than in the former, as opaque bodies are incapable of transmitting the rays of light. That the polished surface of a refracting medium reflects part of the light which it receives, is evident from daily observation. The placid lake, and unruffled stream, exhibit to the eye the images of those objects which are situated on their banks, or float upon their surface. Even the thin panes of a common window reflect the rays of the setting sun; and this effect is still more remarkable on the outside of windows composed of plate-glass, in which the images of passing objects are seen almost as distinctly as in a looking glass. This will account in a great measure for the loss of light which takes place during refraction, as much of it is thrown back into the medium from which it proceeded; but the reflection from transparent bodies is very imperfect unless the posterior surface be coated with a polished opaque substance, such as metallic leaf, or an amalgam of mercury and tin-foil, which forms the reflecting part of common looking-glasses. In this way, glass and precious stones may be made to reflect most of the light which they receive; by such means the diamond, which has been already noted as one of the most powerful refracting substances, becomes a most brilliant reflector. The most complete reflectors of light are the harder metals, as steel, brass, and copper, which admit of being highly polished. All such polished opaque substances, and glasses coated as already described, have received the general name of mirror; but a metallic mirror is more scientifically termed a *speculum*. Mirrors are of various kinds according to the figure of their reflecting surface. Some are plane mirrors, such as common looking-glasses. Others are called convex or concave mirrors, according as their reflecting surface is rounded or hollow, and a peculiar kind of mirror is semi-cylindrical. The following observations relate only to the first three kinds; and for illustrating them, a very simple apparatus is sufficient. A common looking-glass forms the most convenient plane mirror; and where a convex mirror, usually suspended on the wall of a dining-room, and the concave mirrors, commonly used for shaving, are not at hand, large watch-glasses properly prepared will supply their place. If one of these glasses be coated on the concave side with quicksilver and tinfoil, it will form a convex mirror; and another coated on the round side in the same manner will form a concave mirror.

Before describing the effect of mirrors, it is necessary to explain the most general law of reflexion, which is, that if a ray of light fall obliquely on a plane or spherical reflecting surface, it is reflected in such a direction that the angle of reflexion is always equal to the angle of incidence. Thus, in Fig. 7. *a b* represents a reflecting surface on which a ray of light, C B, falls obliquely at the point B, making with the perpendicular A B the angle of incidence C B A. Now, this ray will be reflected from the surface in the direction B *c*, making the angle of reflexion

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A B *c* equal to the angle C D A. This law may be illustrated experimentally by placing a lighted taper before a looking-glass, so that the light shall fall aslant on the middle of the glass. A common two foot rule, opened to a certain angle, must be placed so that one branch of it may form a perpendicular to the middle of the glass, while the other lies in the line between the glass and the taper. Now, if the rule be turned over on the other side, so that the outer branch lies in a direction opposite to its former one, and the observer stand at the extremity of the branch, he will see the flame of the taper in the middle of the glass. The same principle is illustrated less accurately by the common trick of holding a looking-glass from a window, so as to receive the rays of the sun, and making the light fall on the faces of persons passing by; the dazzling light will annoy only those who are in the direction of the reflected rays coming obliquely from the glass.

A few observations will be sufficient to explain reflexion from plane mirrors. It is evident that those rays which strike the mirror in a direction perpendicular to its surface, are reflected back in the same direction; and with respect to parallel rays, they follow the general law above mentioned. But in viewing objects in a plane mirror, it must be recollected that they are seen by the reflexion of pencils of diverging rays coming from the object, which, on being reflected at equal angles become converging till they meet in points at the place of observation. It must also be remarked, that as objects are seen in the direction of the last rays that come from them, they must when reflected from a plane mirror appear as if situated behind the mirror in a straight line with the reflected rays, and at an equal distance with that of the mirror from the place of observation; hence objects are seen more distinct according as they are placed nearer the mirror, and a person may see his whole figure in a mirror sufficiently large, and usually sees it of the natural size, though less distinct in proportion as he is at a greater distance from the mirror. Objects cannot be seen so distinctly in a glass mirror as in a speculum, because part of the light is lost by the refraction of the glass. When the surfaces of a plane mirror are perfectly smooth, equal, and parallel, it reflects objects in their natural form and proportions; but if the glass be unequal in its surfaces, or not of equal thickness, they are more or less distorted,—and this commonly happens in ordinary looking-glasses. When two plane mirrors are placed opposite each other with an object between them, both sides of the object may be seen at the same time, the one side by direct reflexion from the opposite mirror, and the other side by a double reflexion, first from the mirror behind, and then from the opposite one. In this way ladies are accustomed to examine the back part of their dress. When two plane mirrors are inclined to each other so as to form an angle, and an object is placed between them, that object appears multiplied, and its separate images are arranged in the circumference of a circle. The number of images thus formed depends on the number of times the angle of inclination of the mirrors is exactly contained in four right angles. Thus, if they are inclined at a right angle, four images will be formed, if at half a right angle, or 45°, there will be eight images.

Convex and concave mirrors may be compared with concave and convex lenses. The former reflect the rays of light in a diverging or less converging state, and therefore render the objects seen in them smaller, and apparently at a greater distance from the observer, though nearer the surface of the glass than in plane mirrors. This is owing partly to the smaller angle under which the objects are viewed, and partly from the dispersion of many of the reflected rays. It is only about the middle of a convex mirror that objects are seen in their just form and proportions; about the edge of the glass they appear more or less distorted. A concave mirror, again, causes the reflected rays to converge, and has the effect of making the object appear larger and nearer, according as it is nearer the surface of the mirror. Such a mirror has a focus like that of a convex lens between the glass and the object; and if an inflammable body be placed in this focus while the mirror is exposed to the bright rays of the sun inflammation is produced, whence concave mirrors are often used instead of burning-glasses. The distance of the focus of a concave mirror from the surface is determined as in a convex lens, but the means of determining its distance belongs to a subsequent part of this treatise. Convex mirrors, like concave lenses, have only a virtual focus, which is the point at which objects appear most distinct in the mirror. Concave spherical mirrors also more or less distort the objects seen in them; and to produce a mirror which shall give a true image of an object by reflection, it appears that its curvature must be that of one of the conic sections termed *parabola* and *hyperbola*.

If an object, as a lighted candle, be placed before a concave mirror, at a distance from it greater than its centre of concavity, an inverted image of the object will appear between it and the mirror, as if suspended in the air; showing that, after the rays have emerged into a focus, they cross each other and diverge, so as to form an image beyond, as in convex lenses, with this difference, that here the object and its image are both on the same side. If the prese experiment be made in a room where no light is admitted but that of the candle, the image will appear like a bright star. When two concave mirrors of sufficient size are placed opposite each other at a proper distance, with an object a little beyond the focus of one of them, an image of the object will be seen at an equal distance from the focus of the other in an inverted position. This is owing to double reflexion, as in opposite plane mirrors. Several interesting experiments are made with concave mirrors, and some of them will be mentioned in a subsequent part of this treatise.

Much light is lost by reflexion, especially from the surfaces of glass mirrors, in which the light is first refracted by the substance of the glass, and then reflected from its posterior surface. Both in these and metallic mirrors, part of the light is lost by dispersion, from the inequality of the reflecting surface, which, however finely polished, must always retain minute protuberances and hollows, or scratches not visible to the naked eye, but easily discernible with a good microscope.

The theory of the reflexion of light is still more imperfect than that of its refraction. It is the opinion of those who have adopted the Newtonian doctrine on this subject, that the reflexion is owing to a repelling property, in the reflecting body, which drives back the light it receives in proportion to its density, opacity, and smoothness of its surface. Hence the reflexion must be greater from polished metal than from polished transparent bodies. In the latter, it is believed that the light does not strike against the first reflecting surface, and thence rebound like a billiard-ball from an elastic body, but undergoes several reflexions between the two surfaces before it finally emerges, constituting what have been called *fits* of easy reflexion and transmission. See Newton's *Optics*.

## Chap. IV. Of the Phenomena of Colours.

The diversity of colours which we observe in natural objects and appearances, is owing to the different refrangibility of the rays of light by which they are separated from each other; and those only which are capable of producing the sensation of particular colours are reflected to the eye, while the rest are refracted or absorbed. This property of light is illustrated, by means of the prism, in the following beautiful experiment. Suppose a prism, A, B, C, Fig. 8. properly suspended at a hole, F, in the closed window-shutter, E, G, so that a beam of light, S, from the sun, may pass through and be received on a paper attached to the opposite wall, M, N. The image of the sun will appear on the paper at P, T, of an oblong form, rounded at the extremities, and straight at the edges. This image is called the prismatic *spectrum*. Its colour is not uniform and yellowish, as the solar light appears when transmitted through an ordinary lens; but the principal part of the spectrum is composed of seven parallel spaces of different breadths, and exhibiting seven different colours. The lowest colour is red, and above it appears successively orange, yellow, green, blue, indigo, and violet, which is the highest coloured space. If we suppose the coloured part of the spectrum to be divided into 100 parts, the red space is found to occupy 11 of those parts, the orange 8, the yellow 14, the green 17, the blue 17, the indigo 11, and the violet 22.

By this experiment, it appears that the refraction of the prism on the beam of light is exerted in a different degree on the several parts of the beam, causing the lowest rays to be least, and the uppermost most refracted, and that the whole light is composed of seven kinds of rays. Their different refrangibility is supposed to be owing to a difference in their density, or in the size of their particles, so that the red rays are the least refrangible, because they are the densest, and have most momentum. This opinion is favoured by the well-known fact, that red light passes through bodies which resist light of any other colour, and produces most effect upon the eye. Thus the sun and moon, when seen through a horizontal or misty atmosphere, appear red; and when the hand is held between the eye and the sun, it appears semi-transparent, and transmits a dull red light. The white light of luminous bodies undergoes the same changes when transmitted through a prism; and it is inferred, that white light is composed of all the seven rays, and that objects appear white because they reflect all the rays. This is illustrated by a simple experiment. If the broad rim of a wheel be painted with the prismatic colours, in the order and proportions exhibited by the spectrum, and be then swiftly turned round, it will appear of a uniform and white colour; and it is said, that artificial colours of the prismatic shades, mixed together in similar proportions, produce a kind of white. Again, black is said to be the absence of all colour, and that objects appear black because they absorb all the rays of light.

It must not be supposed that the colours of the prismatic image are owing to the inherent colours of the divided rays, but merely to their capability of giving, when reflected, the sensation of the colours. Accordingly, the rays themselves are not said to be red, orange, yellow, &c. but red-making, orange-making, yellow-making, &c. The prismatic colours are termed *primary*, because they always appear in the same order and proportions, but it has been doubted whether there be more than three primary colours; red, yellow, and blue. We know that artificial orange is formed of red and yellow; green of yellow and blue; and that indigo is only a deeper shade of blue: thus it may be inferred, that the orange and green spaces are formed by the conjoined effect of the colours bounding them on either side, and that the indigo is only the expansion of the blue in consequence of the increased refrangibility of the rays. The light thus capable of division is called heterogeneous and compound. That the colours of the spectrum are reflected, is proved by fixing a second prism in such a situation that it may receive the reflected rays from the spectrum, when the former prism is turned so as to throw the rays upon the second. In this way they are refracted by the second prism, and form a spectrum similar to the first. The light of the prismatic spectrum may again be refracted and combined, by placing behind the prism a convex lens, which will cause the colouring rays to converge into a focus; and if a paper be held at the focus, a bright spot of a uniform whiteness will appear, showing that the light before decomposed is now recompounded. If the paper be held either before or behind the focus, the colours will again appear, but in the last case their order will be reversed.

The different refrangibility and colouring properties of light, explain why, in looking through lenses, especially when arranged together in the same optical instrument, objects seen through them appear more or less coloured and confused. This defect is remedied, by forming a lens of two glasses of different refracting power—the one convex, and the other concave, joined in such a manner as to correct the colouring quality and dispersion of the light; and such compound lenses are now commonly employed under the name of *Achromatic*.

The natural colours of bodies alter according to the circumstances in which they are placed, and, in particular, according to their degree of thickness. Many fluids, when looked into perpendicularly, appear of a different shade or colour, from that which they exhibit when looked through towards the light. Thus, water is naturally limpid and colourless, but if we look down into a deep well the water appears black; and sea water, under the same circumstances, has a green colour. Red wine appears much darker when looked down into, than when seen by transmitted light. Air is naturally without colour, but if a thin stratum of it, included between two convex lenses of considerable size, or small convexity, be gradually rendered thinner by pressing the lenses together, numerous coloured rings will appear concentric, or succeeding each other in regular succession. A thin film of water, like what are called soap bubbles, and a sphere of glass blown extremely thin, exhibit similar appearances, and may be made to display all the colours of the rainbow. These, and many other curious phenomena, have been explained according to the theory of fits of easy reflexion and transmission. See Newton's *Optics*, and Young's *Lectures*.

Coloured objects, when long and steafastly looked at, on a white or black ground, appear encircled with colours of a different kind, which are called their accidental colours. See *Accidental Colours*.

## Chap. V. Of other Changes on Light.

Besides the changes, already described, which light experiences from refraction and reflexion, several others remain to be noticed. The first of these is called *inflexion* or *deflexion*. It has been shewn, that, under ordinary circumstances, the rays of light move in straight lines; but modern experiments have proved, that, when the rays pass by the edges of bodies, they are bent inwards or outwards, according to their distance from those edges. Thus, if a beam of light be admitted through a small hole into a darkened chamber, and a paper be held at some distance from the hole, the light will form upon the paper a lucid spot considerably larger than the hole through which it was admitted, shewing that the rays diverge as they pass onwards. If an opaque object sufficiently small be held in the course of the beam, such as a black pin, the image of that object will be surrounded with a luminous rim, called its *penumbra*, the edges of which are fringed, and often coloured. If the interposed object be sharp, as the blade of a knife, it will cause the light to diverge still more upon the paper; and if two knives be placed in the beam, with their edges very near each other, the luminous image will be very much expanded, and its edges bounded by curved lines and fringes. If two beams of light be admitted through two circular holes very near each other, each beam will form a cone of light, and the two cones at some distance from the holes will interfere with each other, producing on the paper an image of two circles crossing each other; and the point where they cross will be more obscure than the rest of the circles, and generally coloured. These appearances are not easily explained on the Newtonian doctrines concerning light, and are thought to be more consonant with the theory of undulation. In most of them, there is evidently an interference of the rays of light, which, in some instances, decomposes it, and thus produces a variety of colours, while, in other instances, the rays destroy each other, and render the image less luminous.

Under this head may be introduced an amusing experiment. If a room, during day light, be so far darkened as to admit only a small portion of the day light through a small opening of a window-shutter, and an object, such as a ruler or the handle of a knife, be held near the opening, so as to cast its shadow on a sheet of paper, the shadow will appear single, and of the usual dark colour; but if a lighted candle be brought near the opening, the object will exhibit two shadows—one blue, from the effect of the day light, and the other deep yellow, from the light of the candle. Here the two lights appear to interfere.

*Aberration* is another change which light undergoes both during refraction by spherical bodies and reflexion from spherical surfaces. In both cases the rays that come from the circumference of the body or surface converge to a focus different from that in which the central rays meet. This difference is called the aberration of the rays, and must be allowed for in determining the joint focus of all the rays. It is supposed to be owing to the different refrangibility of the peripheral and central rays; and as it diminishes the distinctness of objects viewed by refraction or reflexion, much pains have been taken to measure its quantity in different cases, and to counteract its effects. See Smith's *Optics*, Vol. I.

*Double refraction.*—Glass, and most other transparent bodies, produce only single refraction of the rays of light, and of course exhibit only one image; but several crystallized minerals and saline crystals produce a *double refraction*, and show two or more images of the same object from single incident rays. They are therefore called *double refracting bodies*. One of the images is formed by the *ordinary* refraction of the incident rays, but the other is formed by what is called the *extraordinary* rays. In these doubly-refracting bodies there is a line, or more than one, called the axis of the crystal, in which only the refraction is single. If the double refraction takes place towards the axis of the crystal, that axis is said to be positive, but otherwise it is called negative. The laws of double refraction vary according as the crystal has one axis or more than one, but they can be determined only by abstruse mathematical calculation. This property of double refraction was first observed in that variety of calcareous spar called Iceland spar, or crystal, and has since been found to be possessed by rock crystal, some precious stones, especially emerald and beryl, and many crystallized salts.

The *polarization* of light is a property intimately connected with double refraction. It implies the division of the ordinary and extraordinary refracted rays, so that they represent opposite poles. This is another abstruse part of the science, of which it is impossible to give an intelligible idea in ordinary language; and, for the whole subject, we must refer to those writers who have particularly treated of it.

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especially to Malus *Histoire de la Double Refraction*, the *Edinburgh Philosophical Journal*, and Brewster in the *Philosophical Transactions* for 1816, 17, 18, and 19.

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The Principles of *Perspective* would properly be considered under this part, had they not already been anticipated in the treatise on Design.

## PART II. EXPLANATION OF NATURAL APPEARANCES ON THE PRINCIPLES OF OPTICS.

### Chap. I. On Vision.

The structure of the human eye has been described under Anatomy; but to understand the following remarks on vision, it is proper that the reader should have before him a correct outline section of the eye-ball and its contiguous parts. Such a vertical section is given at Fig. 9. and will be understood by the following explanation. A 2, represents the bony orbit of the eye; A H, its upper part; C E G H, its lower convex part next the brain; B H M, the floor of the optic nerve; *xx*, a line representing the axis of the orbit; U V, the *dura mater*; U X, the sheath of the optic nerve; *a d*, the eyebrow; *c w*, the upper eye-lid; *g i*, the muscles that move it upwards; *m n r s t*, the *conjunctiva* of the upper eye-lid; *g* the lower eye-lid, with *k l m n* its *conjunctiva*; *p*, lower eye-lash; 4, 5, 6, the *rectus attollens*, muscle of the eye; 7, 8, 9, the *rectus deprimens*; 10, the tendon of the *obliquus* superior; 11, its fleshy part; from 12 to 18, the optic nerve; 14, the choroid coat; 16, part of the optic nerve passing through its bony canal; 18, its contracted portion where it enters the eye-ball; 22, 24, the eye-ball; 20, 22, its axis; 23, its greatest transverse diameter; 24, the cornea; 25, 24, the space between the cornea and the crystalline lens, containing the aqueous humour; 26, the anterior chamber; 27, 28, 29, sclerotic coat; 31 to 37, the iris; 38, the *pigmentum nigrum* between the choroid coat and the retina; 39, 40, 41, 42 to 46, the crystalline lens; 42, 43, its longer diameter; 44, 45, its shorter diameter; 42, 43, 44, its anterior convexity; 44, 45, its posterior convexity; from 46 to 48 the vitreous humours. We are here to consider the eye as a natural optical instrument, and to show how it several parts are adapted to the purposes of vision. The eye evidently consists of two sets of parts, the one opaque, and the other transparent,—the former serve to inclose and defend, the latter to modify the quantity of light admitted, and to confine it within the sphere of the eye-ball; such are the sclerotic coat which forms the principal defence of the eye-ball, and serves for the attachment of those muscles by which its motions are regulated; the choroid coat, which serves as a basis on which the retina is expanded, and by means of its *pigmentum nigrum* absorbs all unnecessary rays; the eye-brows, eye-lids, and eye-lashes, which shade the eye-ball from too great a glare of light, and regulate the quantity admitted; and the retina, which appears to be the immediate organ of vision. The transparent parts, including the cornea, the aqueous humour, the crystalline lens, and the vitreous humour, transmit and refract the rays of light, so that they may form a picture of the visible object upon the retina. The cornea, like a meniscus glass, merely transmits the rays to the aqueous humour, which refracts them in much the same degree as water would do. The pupil transmits the rays of light thus slightly refracted to the crystalline, and by means of the iris contracts or dilates according as the light is strong or feeble. The figure and structure of the crystalline, which is like a spherical lens, formed of portions of two unequal spheres, and composed of substances whose refractive power increases gradually from the circumference to the centre, admirably adapt it as the principal refracting medium of the eye-ball, and counteract the aberration and colouring property which we have seen renders a single glass lens imperfect. The vitreous humour regulates the final refraction of the rays, and disposes them to converge at proper points upon the retina. The unequal insertion of the optic nerve at different sides in either eye, and at a distance from the axis of the eye-ball, serves to prevent the imperfect vision occasioned by the insensibility of the retina at those points.

The eye is not a fixed passive optical instrument, with which objects are received distinctly only at a certain distance, and in a particular direction. By means of its muscles the eye-ball can be directed to any point within the greater half of a sphere; and partly by means of those muscles, and by other means not so evident, it can be flattened or lengthened, and the crystalline lens can be modified in its figure and relative distance from the retina, so as to accommodate the organ to the various distances of a visible object, from 2½ inches to a very considerable distance. Fig. 10. Plate 148, will give some idea of the mode in which an object becomes visible by the transmission and intersection of the rays proceeding from it, of their course through the humours of the eye, and the picture they form upon the retina in the object A B C. In that figure, pencils of rays are seen proceeding from three points of the objects A B C, and entering each of the eyes, where they cross by refraction, and form the inverted images *c, b, a*, on the retina. The whole object is seen by the eye under an angle, the sides of which meet in the eye, and their inclination is determined by the diameter of the object. That angle is called the *visual* or *optic angle*, and it is less or greater with respect to the same object according as the object is farther from or nearer the eye. This circumstance accounts for the different apparent magnitude of visible objects according to their distances. Thus, if we suppose the object A B C diminished to its half A B, it will appear under the angle subtended by A B; but if it be removed one half nearer the eye, it will appear under the angle subtended by A C. Again, if the object A C be removed to double the distance from the eye, it will be seen under the angle subtended by A B, and will of course appear only half the size.

That the images of objects are really inverted on the retina, is proved by the experiment mentioned in the history; but there is no reason to suppose that an unexperienced eye would view them in that position, though for an explanation of erect vision we can refer only to the action of the mind. The same explanation is sufficient to show why objects appear straight though their images on the retina be curved. The circumstance of single vision with two eyes is not so easily accounted for, but it may be understood from the following considerations. The middle point B, of the object A B C, is seen under an angle, the vertex of which is at B, while it is subtended by a line joining the axes of both eyes. Now, we know that, in natural vision, the axes of both eyes are directed towards the same object or point; and though, at any other distance from the eye than B, the object would be seen double, the two images so completely coincide at B as to represent only a single object to the mind. This fact is illustrated by a simple experiment. If a person place himself at some distance from a lighted candle, and direct both his eyes stedfastly towards its centre, he will see the candle single. Now, if holding a small object, as a pencil, on the right side of his right eye, near his face, he make it slowly pass before his eyes, to the left side, he will evidently see it cross the candle twice, showing that its image has been depicted successively in both eyes. If he advance the object mid-way between his face and the candle, and again make it pass both eyes with the same velocity, the time that elapses between its passing one eye and the other will be considerably shorter; and if he once more make it pass almost in contact with the candle, the images will be formed in such a rapid succession as scarcely to be distinguished from each other. This proves that at the object itself the images coincide, and are of course seen as one by the mind's eye. Another proof that images are thus seen in coincidence, is drawn from the symptom of squinting, in which the axes of the eyes are directed different ways, so that an object can then be seen single only with one eye. An object is seen more clearly with two eyes than with one, from the coincidence of the two images, just as two candles close together give more light than when apart.

The preceding observations apply to natural or unassisted vision. If an object be seen by the healthy eye through a convex lens at the proper focus, the visual angle is increased, and the object appears larger or nearer than usual, as the rays proceeding from it are made to converge more than in unassisted vision. On the contrary, when an object is seen through a concave lens, the circumstances are reversed; the convergence is less, and the object appears smaller or more remote. These circumstances explain the defects under which long-sighted or old persons, and short-sighted persons, labour. In the former the visual rays converge in a point behind the retina, and the image in this membrane is indistinct without the assistance of convex glasses. In the latter the rays converge before the retina, and require the assistance of concave glasses to diminish the convergency, and bring them to a focus upon the retina.

Though refraction be the principal effect of the humours of the eye, many of the rays of light are reflected from the cornea, as is evident from images that appear on the external surface of that membrane. Rays are also reflected from the iris, giving the sensation of the colours by which that part of the eye is distinguished. Some rays are reflected even from the interior, especially when the *pigmentum*, instead of being dark, is of a light colour, or is perhaps altogether wanting. In these cases, so much light is reflected from the choroid coat, that the person can see little in a strong light, and sees best in twilight. This happens with Albinos, and those animals which seek their prey by night.

*Shadows*, though very familiar appearances, merit some notice in this chapter. It is well known that they arise from the interposition of an opaque or imperfectly transparent object, between a luminous body and the eye; that they are darker in proportion to the opacity of the interposed object, and the brightness of the luminous body, and that they are always seen on the side of the interposed object most remote from the luminous body. Shadows formed during sunshine or moonlight are longer or shorter according as the sun or moon are nearer or more above the horizon, because, from the greater or less refraction of the rays by the atmosphere, they are seen under a greater or less angle; they are perpendicular or straight only when the sun or moon is in its meridian, because only then the interposed object is exactly opposite the luminary. In all other positions of the luminary, the shadow is oblique, or is seen in perspective. Shadows produced in a room by an object opposite to an artificial luminous body, as a fire or candle, appear larger in proportion as the object is nearer to the luminous body, because they are then seen under a greater angle, and obstruct more of the luminous rays; but when the object is close to the opposite wall, the shadow occupies nearly the same space with the object, for the contrary reason. Shadows are generally without colour; that is, they are more or less of a black hue, but, in certain circumstances, especially under a serene atmosphere, they are often tinged with blue or green. This is supposed to be owing to the interference of more refrangible rays with the ordinary white rays, and the colours are therefore most conspicuous on the edges of the shadow.

## CHAP. II. OF THE NATURAL APPEARANCES CONNECTED WITH THE REFRACTION OF THE ATMOSPHERE.

The atmosphere is a refracting medium composed of strata or layers of different density, those next the earth being the densest. Such a medium must, therefore, refract the rays of light that pass through it more and more as they approach the earth's surface, and must produce changes in the apparent situation and magnitude of objects beyond or within

Atmospheric Refraction.

it, according to its density, or according as the rays pass more or less vertically through it. In the most serene atmosphere, when the rays of light from a distant object, as the sun or moon, pass through the horizontal strata in the morning or evening, they suffer considerable refraction; and, accordingly, we then see the sun or moon sooner or longer, and larger than it would appear if no such refraction had taken place. Thus, in Fig. 11. suppose P to represent a person on the earth, looking towards the rising or setting sun, and H O to denote the visible horizon; were there no refraction of the atmosphere, the person would not see the rising sun S till it reach the point O, and would lose sight of the setting sun as soon as it had reached the same point. But, from the horizontal refraction, he will see the rising sun above the horizon at R, when it is in reality below it at S, and he will continue to see the setting sun above the horizon when it has really sunk below it. From the same cause, those luminaries appear larger and redder when seen through a misty atmosphere, as then the refraction is increased and the red-making rays make most impression on the eye. In the same manner, when objects within the atmosphere, as trees, buildings, or persons, are viewed through a haze, they appear larger, but less distinct than through serene air, on account of the greater refraction in the former case.

The appearances just mentioned are ordinary, and take place under the usual refraction of the atmosphere; but others have been occasionally observed, which are accounted for by an unusual state of atmospheric refraction. In approaching a coast, navigators sometimes see its headlands, and other prominent objects, higher and nearer than usual, though the atmosphere be clear and serene. This appearance has been called *looming*. A still more extraordinary phenomenon, in which the images of objects on the earth's surface are seen above, beneath, or beside them, in the air or the water, commonly in an inverted position, is called, by the French *mirage*, and by the Italians *fata morgana*. This phenomenon has been observed chiefly with respect to ships, passing by the coast. As similar appearances may be produced artificially, by experiments in which the density of the refracting medium is altered in its different strata, the natural phenomena are explained on the same principles. Thus, according to Mr Huddart, (see *Phil. Trans.* 1797,) from the evaporation of water, the refractive power of the air is so altered as to be greatest at some distance above the surface, and he calls the stratum of greatest density the *line of maximum density*, and supposes that the density gradually diminishes above and below that line. The rays of light passing through such a medium, will be refracted into curves, with their concavity upwards above the line, and their convexity downwards below it. From this circumstance, two pencils of rays from each point of the object will meet the eye of the observer, and an inverted image will be produced. In cases where the image is seen on one side of the object, it is supposed that the strata of unusual refraction are inclined to each other sideways.

## CHAP. III. OF NATURAL APPEARANCES CONNECTED WITH REFRACTION AND REFLEXION.

Of the Rainbow.

Several of the appearances observed in the atmosphere are owing to a combination of refraction and reflexion. The blue colour of the sky is one of these, and appears to be produced by a separation and subsequent reflexion of the blue rays of the sun rendered lighter by a mixture of white light. This combination is attributed to the polarization of light. The varied tints in a cloudy atmosphere seen at sun set, and occasionally at other times, evidently arise from the reflexion by the opposite clouds of the sun's rays passing through an atmosphere possessed of a high refracting power, and they are more varied in proportion as that power is greater. In slight refractions red is the prevailing tint, and in proportion as the refraction is greater, yellow, green, and purple are added.

The most brilliant of these natural appearances is the *rainbow*. This beautiful phenomenon, as is well known, appears only during a shower of rain while the sun shines, and when the observer is situated between the shower and the sun, with his back to the latter. He is then placed in the centre of a circle, in the circumference of which is the rainbow. This meteor is sometimes single and sometimes double. In the former case the luminous arch exhibits all the prismatic colours in their usual order, with the violet on the inner or concave, and the red on the outer or convex edge. When there are two bows, as in Fig. 12. the lower or inner is called the principal bow. It is usually bright, and exhibits the colours as just described. The upper or outer bow, called secondary, is fainter than the other, and in it the colours are reversed, the red being innermost and the violet outermost. The brilliancy of the colours is in proportion to the brightness of the sun, or the clearness of that part of the sky in which it appears. Both arches are circular, but of different diameters; that of the inner being 82°, while the outer has a diameter of 104°.

From the circumstance in which a rainbow appears, it is evident that it is caused by both refraction and reflexion of the sun's rays by the drops of rain, and this is farther proved both by observations and experiment. If a person be standing near a waterfal during sunshine, in such a position that he can see the spray while his back is to the sun, he will observe an appearance very similar to the rainbow. Again, if drops of water be sprinkled from a brush or ejected from a syringe, the farther extremity of which is perforated like the vase of a watering-pot, they will exhibit the prismatic colours. The refraction and reflexion of the rays by the drops of rain, are different in the primary and secondary bows.

Thus in Fig. 12. E F represent two drops of rain in the lower bow; G H, two drops in the upper bow; S E, S F, are two rays of the sun, incident on the upper part of the drops E and F, and after suffering two refractions and one reflexion within the drops emerging from their lower surface, are reflected to the point O, the place of observation. The rays S G, S H, coming to the upper bow, are incident on the lower surface of the drops G, H, and after suffering one refraction, two reflexions, and a second refraction within the drops, emerge from their upper surface to the same point O. In Fig. 12. the emerging rays are represented as single; but as they show seven different colours, they are each composed of seven rays, as seen in Fig. 13. where the incident rays S D, S D, after being refracted and reflexed as just described, finally emerge at E and F, each divided into seven. It is also evident, from this last figure, that the divided rays make different angles with their correspondent incident ray, according to their difference of refrangibility, the red-making ray forming the greatest, and the violet-making ray the least angle.

Other lesser bows are occasionally seen accompanying the primary bow, but they are composed of fewer colours, generally of two, red and green. Comparing the appearances of rainbows with the recent observations on polarised light, it is concluded that a polarisation of the rays takes place in their passage through the drops of rain.

The same principle seems necessary to account for the meteors called *halos*, *coronæ*, and *parhelia*, which are described under METEOROLOGY. The crystallized particles of ice which seem to float in the atmosphere when those appearances are observed, have the effect of polarising the rays of light, and thus producing coloured rings. The luminous and coloured circles sometimes seen round a lighted candle have probably the same origin.

To complete this part of the subject, it remains only to offer a few remarks on the lustre, transparency, and colours of natural objects, as they are varied by particular circumstances.

The lustre of bodies depends on the quantity of light which they are capable of reflecting; and as their reflecting power is in proportion to their refracting power, their lustre will be greater according as they are more capable of refracting the rays of light. Hence diamond, which is possessed of a high refractive power, is also eminent for its lustre; and flint-glass is more brilliant than crown-glass, because, by the addition of lead in the composition of the former, its refracting power is increased.

The transparency of bodies depends partly on their nature, but still more on the thinness to which they can be reduced. Thus a thick piece of talc is only pellucid, or transmits the rays of light without enabling us to see objects distinctly through it; but when separated into very thin plates it becomes as transparent as crown-glass, and may be employed for the same purposes. Whalebone, horn, and ivory, in the lump, are opaque, but when reduced as thin as possible by cutting and scraping, they not only transmit light, but enable us to distinguish objects. Metals are naturally the most opaque of all bodies; but even some of them, especially gold, may be reduced to such a degree of thinness, that light can be perceived through them. Again, bodies which are by nature scarcely pellucid, as paper and parchment, become transparent when impregnated with oil. From these facts it is concluded, that all bodies, opaque as well as transparent, are capable of being penetrated to a certain extent by the rays of light, and that when their surfaces are highly polished, as in the case of metallic mirrors, they acquire a thin translucent film, by which the light is first admitted and then reflected. Bodies naturally transparent, as oil of turpentine and water, become less transparent when shaken together; and if they be more intimately combined by the interposition of a third transparent substance, as alkaline ley, they become perfectly opaque and white. This is owing to the reflecting power of the substances being increased when brought nearer together. But it would be improper to enter further in this place into the variations of colour produced by chemical combination, as in this way the nature, and of course the colour of the compound, is materially changed.

The colours of natural objects, such as the plumage of birds and the skin of some reptiles, are materially changed, according to the degree of light and other circumstances under which they are viewed. Thus, the colours of a wild duck's wing or neck appear green or blue, according to the light in which they are seen, or the obliquity under which they are reflected, and the chameleon exhibits different colours, according to that of the ground on which he is placed, or the degree of vivacity and vigour which he possesses. The colours of bodies also depend much on their bulk and thickness. Thus whalebone in the piece is black, but when cut very thin it appears brown, and the scrapings of it are white. Common flint is usually of a black or dark-brown colour, the shade of which becomes lighter when it is broken into small pieces, and changes to white when the flint is ground to powder.

To account for these variations in colour, it must be observed, that all bodies, however solid, are more or less porous, and usually contain in their interstices some substance, as water or air, of a different density from that of the body itself. The rays of light are supposed to be reflected from those pores or interstices, but in a different manner according to their size and density; and as these are changed by reducing the body to a smaller bulk or thinner substance, the degree of reflexion, and consequently the colour, become altered in proportion.

## PART III. OF THE CONSTRUCTION AND USE OF OPTICAL INSTRUMENTS.

IN this part are not only to be considered the construction and general uses of optical instruments, with the exception of the MAGIC *lantern*, already described under that head, but some of the more useful and amusing experiments which have not been anticipated in the preceding parts, with the apparatus employed for constructing them.

### CHAP. I. OF SIMPLE OPTICAL INSTRUMENTS.

*Lenses* are the most simple and among the most useful optical instruments. Their general form and denominations have already been noticed under Part I.; but it is necessary here to be more particular respecting convex, concave, and periscopic lenses, their figure, foci, and the method of grinding, polishing, and fitting them for use. Convex lenses are in general made equally convex on both sides, or both surfaces are similar portions of equal spheres; but for particular purposes, or to suit certain peculiarities of sight, they are sometimes formed with one surface more convex than the other. In single convex and double convex lenses of equal convexity, the focus is easily determined when the diameter of the circle of convexity is known, as in the former case the focal distance is equal to that diameter, while in the latter it is equal to half the diameter. But when the diameter is not known, the focus may be found to a degree of accuracy sufficient for ordinary purposes, by holding the lens between a wall and an opposite window, and marking the distance at which the image of the window-frame is depicted most distinctly on the wall or paper. A method still more accurate is, to cover one side of a lens with a piece of paper of the same size, in a diameter of which are cut two small circular holes at a little distance from each other. If the lens thus prepared be exposed with its uncovered side to the sun's rays, opposite a fixed piece of paper, the images of the two holes will be depicted on the paper, and at a certain distance from it they will coincide. The distance between the lens and paper, where the coincidence takes place most distinctly, is the focal distance. For lenses of unequal convexity, where the diameters of the circles of convexity are known, opticians find the focus by the following rule: As the sum of the radii, or semi-diameters of both circles, is to the radius of either, so is double the radius of the other to the focal distance. Concave lenses, when double, are always equally concave, and their virtual focus is found by covering one side of the lens with a paper prepared as for convex glasses, and drawing on the wall or paper on which the images are to be received, two similar holes, at a distance from each other, double that of the holes on the lens; then if the lens be exposed to the sun's rays, and moved to or from the paper, till the images of the holes on the lens fall exactly on the other holes, the distance between the lens and paper, when that takes place, is the focal distance of the lens. In concave lenses, it is important to ascertain whether they be truly ground, or whether the centre of concavity correspond with that of the lens. This may be known by holding the glass behind a lighted candle, so that the image of the flame may be reflected from both concave surfaces. In every point but one, the images will be distinct, and at one point they will coincide. If this point appear in the middle of the glass, the lens is true. Periscopic lenses will be considered presently under spectacles.

All these lenses are usually made of flint-glass, or transparent pebble, of the proper thickness, and free from specks or clouds. They are first cut into a rude shape with strong scissars, or pincers for the purpose, and this is best done under water. They are next ground into a more regular form on a grindstone, after which they are ready for the principal grinding into a spherical form. For this process, certain pieces of apparatus, called gauges, and tools with proper handles, a turning lathe, some pitch, emery, pumice-stone, and flour of putty, or colcothar of vitriol, are required. The gauges are for giving the glasses their spherical surface, or rather for ascertaining its regular curvature. They are formed of a piece of sheet copper or brass, on which an arch has been described with the proper radius, and of a breadth a little more than the diameter of the intended lens, and the metal is then cut through in the direction of the arch, or filed down till the arch is left clear. If the gauge be intended for convex glasses the arch is left concave, and convex if for concave lenses. The tools are moulds of brass, of a circular shape, and a diameter rather greater than what is called the aperture of the proposed lens. They have a grinding face made exactly convex or concave, according to the lens to be ground on them; and they are firmly cemented to pieces of wood, that may be fixed in the turning lathe. To render their grinding faces more truly spherial, a convex and a concave tool of the same size and radius are ground carefully together, with flour emery between them, till their spherical surfaces accurately correspond. To commence the grinding, the plate of glass, prepared as above described, is fixed with pitch upon a wooden handle long enough to be conveniently held, taking care that the extremity of the handle is exactly in the middle of the glass. The glass thus fixed is now grounded upon the corresponding tool with sand, and then with emery, either by means of the lathe, or, what appears preferable, by the hand, so that it be kept accurately within or upon the tool; and it is examined from time to time with the proper guage, till the surface be found perfectly spherical. It is not easy to describe this process, which is nice and tedious, and can be properly understood only from actual observation. When the spherical surface is found complete, the glass is still rough, and the lens must be grounded again upon the tool with powdered pumice alone, which removes most of the asperities. After this, it is polished on a bed of pitch, fastened to a proper handle, and formed into the same convexity or concavity as the lens, by pressing it with the concave or convex tool. The pitch is sprinkled with putty, or colcothar, which gives the final polish. When one side of the lens is finished, it is removed from the handle, and the pitch cleaned off with oil of turpentine, or spirit of wine; and the finished surface is then fixed on the handle, that the other side may be ground and polished in the same manner.

Lenses are fitted up in frames of horn, tortoise-shell, or metal, for ordinary purposes, as when intended for spying, magnifying, or burning glasses, or in double frames for spectacles. For all these purposes, horn and tortoise-shell form the most convenient frames, as they produce but little reflexion, and do not dazzle the eye. The lens is fixed in these frames by steeping the horn or tortoise-shell in warm water till it expands, then introducing the lens, and allowing the frame to cool, when by its contraction the lens is fixed firmly in the frame. This is the only inconvenience attending these frames, as those of metal are usually made to open and shut with a screw for admitting and fixing the lens.

Single lenses, for viewing objects at a moderate distance, are either doubly concave, or concave-periscopic; and the latter are preferable, as they give a greater field of vision. Reading glasses are usually of an oval form, for embracing a greater space, and they are always convex, as they may be adapted to either long-sighted or short-sighted persons, according as they are held farther from, or nearer to the page. Reading-glasses of moderate convexity form pretty good *burning-glasses*, and may be employed for lighting a pipe, or kindling a fire with dry combustibles, by the bright rays of the sun. But when these glasses are intended to produce a greater effect, they must either have a great convexity, or be of considerable size; and, in this latter case, they must be fixed in a frame, moveable on two opposite pivots, like a toilet-glass. *Spectacles* are of various kinds, according to the purposes for which they are intended. The simplest instruments of this description are commonly called *gogles*, and are used to defend weak eyes from dust, or from too great a glare of light in the open air. They consist of two plane glasses, colourless for the former case, and grey or green for the latter, fixed in short cylindrical horn frames, with a front of leather, and strings to secure them round the head. The frames have at least three holes in their circumference, for exhaling the vapour from the eyes, and those holes should be larger than they are commonly made. The next kind of spectacles, usually called *preserves*, differ from gogles chiefly in the mode of fitting up. The glasses are plane, and either of a green or grey colour, and they are fixed in a common spectacle frame, which should be composed either of horn or tortoise shell. They are intended for weak eyes, but should not be hastily adopted, as, when used without necessity, they tend rather to increase than diminish the weakness of sight, by rendering the eyes more susceptible to the influence of ordinary light. The spectacles most commonly employed are intended to counteract long-sightedness or short-sightedness, and are of course either convex or concave. For long-sighted or old persons, they should be adapted to the degree of the infirmity; and such persons should begin with glasses with a small convexity, to be gradually increased, as the infirmity becomes greater. Opticians distinguish lenses by numbers, counting those of the smallest convexity No 1. and so on to 9, 10, or higher, and they generally recommend No. 1. to those who first begin to wear spectacles. But the choice of the number must be regulated by the circumstances of the case, and it is best to have the opinion of a scientific oculist. In general, for spectacles to read with, the distance, at which the person sees near objects most distinctly, should be first determined, and then that at which it would be most convenient for him to see them. This last distance will regulate the focus of the glasses he should use. Convex periscopic spectacles seem to possess little advantage over those with double convex glasses, and they have the inconvenience of increasing the aberration of light, especially at short distances. Concave periscopic glasses are liable to the same inconvenience; but as they are calculated for viewing more distant objects, it is less perceptible, and is compensated by the greater field of vision they embrace, in consequence of their concave surface being next the eye. The front of spectacles should have a slight curvature, so that the glasses may have a direction towards the nose, by which means their axes correspond more exactly with those of the eye-balls. Spectacles are now often made with side glasses or blinds, of green or grey glass, moving on hinges at the outer side of each lens. This is an improvement, as it concentrates the light in front, and is particularly useful for weak eyes; but the frames of such spectacles should not be made of metal, as they are then inconveniently heavy. The form and general properties of plane convex, and concave mirrors, have been sufficiently described under Part I. For optical purposes, the two former are best made of flint-glass, which has a greater reflective power, and admits of a higher polish than any other kind of glass. The plates for plane mirrors should be thick enough to admit of being accurately ground into parallel surfaces, and should not have a bevelled margin, as in looking-glasses. These, and all other optical mirrors, should be set in common black frames, made as plain as possible, to prevent confusion from marginal reflection. Convex mirrors are best made in the form of a meniscus, and should be ground with proper gauges and tools, to render their surfaces accurately spherical, after which they are silvered on the concave side. Concave glass mirrors are formed of a thick plane glass, ground concave, but are silvered on the plane surface. Those used for shaving should be large enough to shew the whole face at one view. But optical concave mirrors, especially when intended to form a part of compound instruments, are best made of metal. For single mirrors, plates of double block tin, stamped or beaten into a spherical form, are very convenient, as they cost little, take a good polish, and are easily kept clean. They are usually placed on a stand, like that of a fire-screen, by means of a spring tube, by which they are adjusted at any convenient height.

*Specula* for reflecting telescopes require great nicety in their construction and finishing, as they should be the most perfect reflecting mirrors. They are formed of a mixture of copper, tin, and a little arsenic, with the addition of silver and brass. The most perfect metal for this purpose yet discovered is composed of 32 parts of copper, 15 of grain tin, one of arsenic, and the same of silver and brass. These metals are melted together, and then cast into the rough form and size of the speculum, by pouring the fluid compound on a bed of tenacious sand, formed into the proper shape by a pewter mould, and surrounded by a rim to keep in the metal. The speculum thus roughly cast, is then ground into the proper size and shape on a grind-stone, and its concavity is perfected, by first grinding it on a leaden tool of an elliptical form, with emery, and afterwards on a brass tool, like lenses, till it acquire an exact and tolerably smooth concavity. It is finally polished, on a spheical surface of pitch, sprinkled with colcothar, till it has received the greatest possible lustre. The grinding of specula is still more tedious and delicate than that of glasses, and the polishing should be conducted in a close apartment, free from dust.

Many amusing experiments are performed with mirrors. One is called the *optical paradox*. The apparatus for it consists of three tubes, joined to each other at right angles, and having pieces of plane mirror fixed within their cavities, so as successively to reflect the rays of light entering by a short tube at one end, from one mirror to another, till they finally emerge by a short tube at the other end, next the eye. By this means, an object may be seen apparently through a crooked tube, which constitutes the paradox. But the most interesting experiments are made with concave mirrors. If a person stand at some distance behind the focus of one of these mirrors, he will see an image of himself inverted near the focus, and if he stretch out his hand towards it, the hand of the image will appear to advance to meet his. If a crystal bottle, half filled with water, be placed on a stand, a little beyond the focus of a concave mirror, its image will also appear inverted, and the water will seem to be suspended in the upper part of the image. If the bottle be then turned, so that the water may flow out, the reflected bottle will appear to be filling with water, or rather as if it spouted out water. What is called the *real apparition* is an experiment performed with two concave mirrors, placed in separate adjacent apartments, opposite each other, with a hole in the partition wall between them. Then, if an object calculated to surprise, be placed in one apartment, near the focus of one mirror, the reflected rays will pass through the hole to the second mirror, and being again reflected, will exhibit an image near the focus of the latter. The last experiment of this kind that can be noticed here has been called the *air-drawn dagger*. In Fig. 14. A B C represents the thin partition of a room, having a convex lens fixed in a slanting direction, so that a person loooking through it may see any object reflected from the mirror D. Now, if any object, such as a dagger, be held above at E, so that its image may be reflected from the mirror through the lens, a person going to look through the lens, will be startled, by seeing the image immediately opposite his eye, as represented in the figure.

Concave mirrors form the most convenient burning instruments, as when an inflammable body is placed in the focus of one of these mirrors, exposed to the bright rays of the sun, it quickly takes fire. It is supposed that the burning instruments, with which Archimedes set fire to the Roman fleet, at the siege of Syracuse, were of this kind. Like convex burning glasses, burning mirrors of any considerable size must be suspended in a frame by pivots, and are best made of metal.

*Anamorphosis.*—One kind of mirror remains to be described,—the *cylindrical*. Mirrors of this kind are usually made of a plate of glass, bent into the form of a half cylinder, silvered on the inside, and fitted with a frame so as to stand on a table. The rays of light are reflected from such a mirror in so many directions as to produce a distorted image; and if an ordinary picture of a regular object, as a portrait or landscape, be laid on a table close to the mirror, its reflected image will appear a mass of confusion. But if a picture be drawn according to optical principles, in such a manner that the rays from it may fall in a proper direction on the cylindrical mirror, a regular image will be produced. This contrivance has been called an *Anamorphosis*, and forms one of the amusing experiments in optics. The distorted picture is usually drawn on a board, which has a circular cavity at the back, suited to the curvature of the mirror, so that it can be applied sufficiently close for the mirror to receive all the rays. See ANAMORPHOSIS.

## CHAP. II. OF COMPOUND OPTICAL INSTRUMENTS.

*Telescopes* are among the most important optical instruments. They are usually divided into refracting and reflecting telescopes. The former are the most common, and have been longest known. They consist of a principal tube, generally of wood or metal, of a cylindrical, or sometimes conical form, made perfectly smooth, and blackened on the inside to confine the rays of light, and of another tube made to slide stiffly backwards and forwards within the other. They have always two or more lenses, one of which is fixed at the farther extremity of the principal tube, and is called the object-glass, while another, called the eye-glass, is fixed at the near extremity of the sliding tube. The object-glass is always convex, and the eye-glass generally convex but sometimes concave. The most simple form of the telescope is that called *opera-glass*, which is intended for viewing objects distinctly at a moderate distance, as across a street, or within the limits of a theatre. It consists of two lenses, an object-glass and an eye-glass, the former of which is plano-convex, and the latter doubly concave. The principal tube is short and cylindrical, and usually formed of ivory or metal, and the other tube is sometimes single, and sometimes formed of several very short tubes, one sliding within another, so as to accommodate the instrument to the pocket, and enable the observer to regulate the distance between the object-glass and eye-glass, according to the distance of the object, or his peculiar vision. The less the distance of the object the farther must the eye-glass be drawn out for ordinary vision; but near-sighted persons require a less distance between the glasses, and for them the eye-glass should be more concave. Another telescope, called astronomical, because it is employed for viewing the heavenly bodies, also consists of two lenses; but they are both convex, though of different foci, the object-glass having the greatest focal distance, and of course the least magnifying power. The lenses are arranged at such a distance as is equal to the sum of their principal foci. The effect of such a telescope is illustrated by Fig. 15,—where $l\,m\,n$ is the object-glass, whose focus is at $f$; and $b\,c\,d$ is the eye-glass, with its focus at the eye. Now, if pencils of rays proceed from a distant object, as $y$, $z$, they will be refracted by $l\,m\,n$, so as to meet and form an inverted image at $e\,f\,g$, and passing thence to $b\,c\,d$, will be again refracted so as to meet in the eye, and there form an erect image of the object. Hence, an object seen through an astronomical telescope must appear inverted to the eye.

*Fig. 10.*

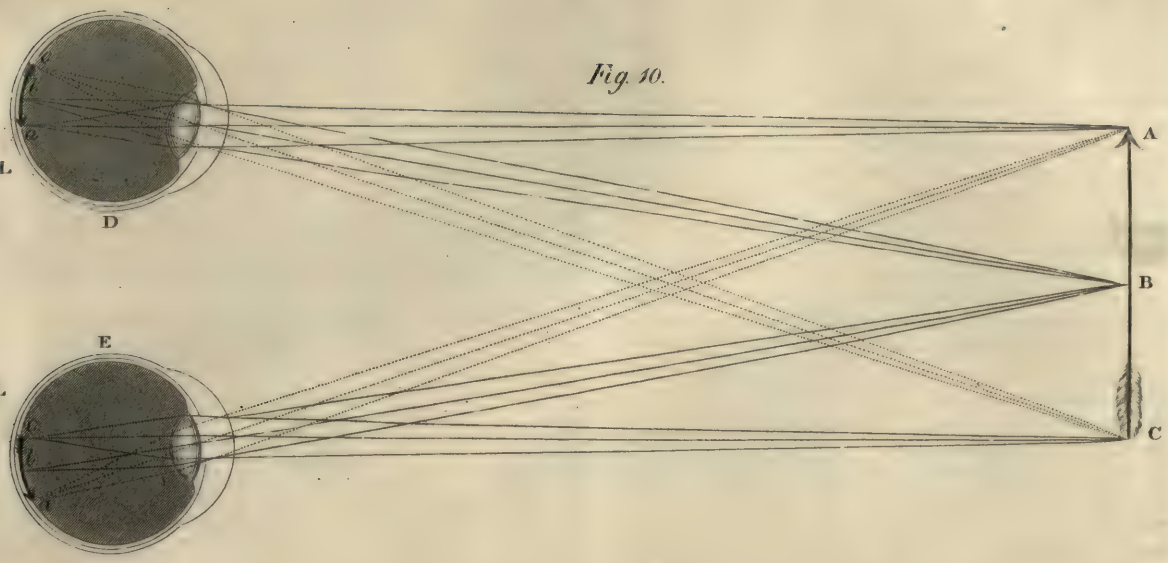


*Fig. 11.*

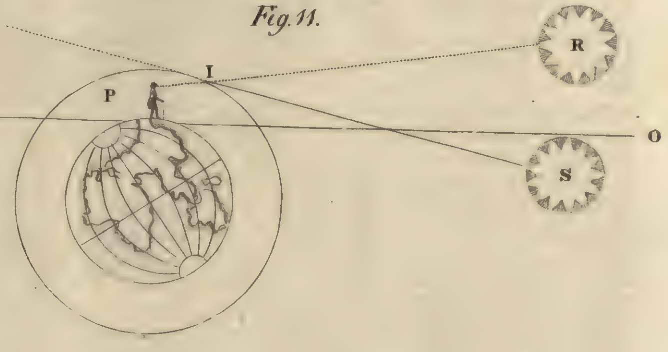


*Fig. 13.*

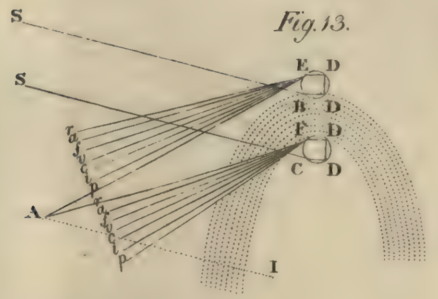


*Fig. 12.*

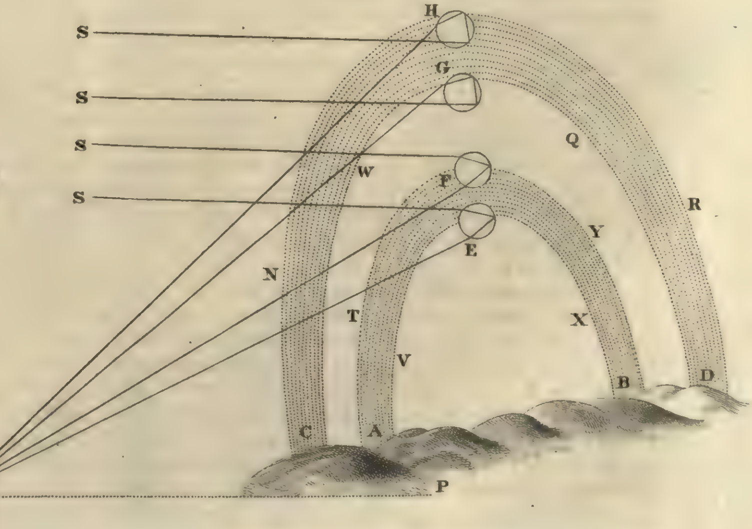
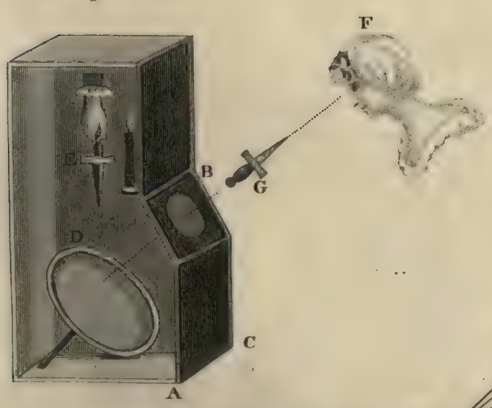


*Fig. 14.*



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These two simple combinations of lenses are sufficient to explain the general principles of telescopes. The effect of the object-glass is to magnify the object, and thus diminish its apparent distance, while the eye-glass renders the image formed more distinct, and if convex increases its apparent magnitude. From what has been already explained under *Vision* in Part II. it is evident that the apparent magnitude of a distant object is in proportion to the angle which it subtends at the eye; and as, to the unassisted eye, this angle is very small, the advantage of a telescope is to enlarge the angle, and thus make the object appear nearer.

The instruments now described are not calculated for viewing distant terrestrial objects, as the opera-glass has but little magnifying power, and the astronomical telescope shews objects inverted, which, though of no consequence in viewing the heavenly bodies, would be a great inconvenience in observing land objects. For this purpose, the land telescope or perspective glass has been contrived, and is illustrated by Fig. 16. This telescope consists of an object-glass, *l m n*, fixed at the extremity of the principal tube, and 3 or 4 other convex lenses *b, c, d*, fixed in the sliding tube, and all called eye-glasses; that next the object-glass being the first, and that next the eye the last eye-glass. The sliding tube is composed of two or more pieces, for the purpose of more conveniently fixing and taking out the eye-glasses, which are placed at a distance from each other, equal to the sum of their focal distance, and between them are usually fixed circular plates, perforated in the centre, for confining the rays of light. The pencils of rays from the object falling on the glass *l m n*, are refracted by it so as to meet and form in its focus an inverted image *e f g*, and thence diverging are received by the first eye-glass *b*, which refracts them, and transmits them to the second *c*, by whose refraction they are brought to a focus, and form an erect image, *h i k*, behind the third eye-glass, which refracts them to the eye, so as to form as usual an inverted picture on the retina. Hence, objects seen through such a telescope appear in the same position as they would to the naked eye, but magnified so as to diminish their apparent distance. As all the eye-glasses in this instrument are fixed at certain relative distances from each other, only the distance between the first eye-glass and the object-glass, can be altered by drawing out the sliding tubes, and in this way the telescope is adjusted to different distances or peculiarities of vision. In order to enlarge the field of vision in perspective glasses, they are now usually made with the nearest eye-glass formed of two plano-convex lenses, instead of one double convex lens.

*Achromatic* object-glasses are a still greater improvement on these and other telescopes. The general effect of such glasses, in correcting the aberration of the rays and the colours produced by their different refrangibility with ordinary lenses, have already been noticed in Part I. Achromatic object-glasses are commonly made of three lenses of different refracting power; two convex, made of crown glass, and one doubly concave of flint-glass. When these are placed together with the concave lens between the two convex ones, they form an object-glass, which exhibits the image of the object as distinct and free from colour as appears possible, and they are accordingly now employed for all the best telescopes. A superior achromatic object-glass, recommended by Dr Herschel, is formed of two lenses, the outer of which is made of crown glass and doubly convex, the inner surface being more convex than the outer; while the inner lens, made of flint-glass, is concavo-convex, the concave surface being adapted to the posterior convexity of the outer lens. It is evident that this construction has been suggested by the manner in which the crystalline lens and the vitrious humour are connected in the human eye. It is extremely ingenious, and a full account of it, with the general principles for the construction of achromatic glasses, is given by Dr Herschel, in a paper published in the Edinburgh Philosophical Journal, Vol. VI. p. 361. This improvement renders unnecessary the inconvenient length, formerly given to the principal tube of telescopes; and it is found that, with it, the length need not exceed three feet for ordinary instruments.

What is called the Galilean telescope resembles the modern opera-glass, in being composed of a concave eye-glass and a convex object-glass; but the latter is doubly convex. This telescope is superior to the common astronomical telescope, as being of a more convenient length, and exhibiting the object in an erect position; but it has the disadvantage of possessing a smaller field of vision, and is now seldom employed.

*Reflecting telescopes* consist of one or more metallic specula within the principal tube, and of lenses for conveying the reflected images to the eye. They are of various kinds and denominations. One of the most common is the Gregorian telescope, the outline of which is given at Fig. 17. At the bottom of the principal tube, T T Y Y, is fixed a concave speculum E N, with a perforation in its centre; and near the other extremity, directly opposite the focus of the large speculum, is placed a smaller one O P, so that, by a contrivance on the outside, it may be adjusted at different distances from the first. Joined to the large tube in its centre is a smaller one, S, furnished with two lenses, one plano-convex at P O, and the other convex-periscopic, L L. The rays proceeding from a distant object, and entering the farther end of the tube, will be first reflected by the larger speculum, and form an image at its focus C, whence proceeding to O P, they will again be reflected by that speculum, and, passing through the perforation in the large speculum, will cross in the smaller tube, and be transmitted through the lens to the eye, so as to produce a distinct and magnified image of the object. By the use of reflectors in this and similar instruments, several advantages are gained. The principal tube of the common reflecting telescope may be so short that, in the length of a few inches, it will produce as great a magnifying effect as a common refracting telescope of as many feet. The objects viewed with it are also more distinct and free from colour than when viewed through spherical glasses, especially if the principal reflector be ground of a parabolic form, as is usually the case. But the instrument in the form just described is imperfect, and several improvements have been made upon it. The first of these deserving notice is by Newton, and is thence called the Newtonian telescope. It differs from the former in having the principal speculum entire, while a plane mirror is placed at the other end of the tube in an oblique direction, opposite the centre of the former. Instead of the short tube at the end of Gregory's telescope, one still shorter is placed in the side of the instrument opposite the plane mirror, through which the image of the object, produced by the principal speculum, is directed to the eye and magnified by means of proper lenses.

*Herschel's Telescope.*—Not to mention other improvements on the reflecting telescope, it will be sufficient here to give a short description of that constructed by Sir William Herschel, which is probably the largest and most powerful at present in existence. It consists of an open tube 40 feet in length, and contains only one speculum, the aperture of which is equal to four feet, and its weight is about a ton. This speculum, when the telescope is not in use, is defended from damp by a tin cover with a rim of cloth, so as to fit close upon the speculum. Connected with the principal tube, is a smaller tube, fitted with eye-glasses for viewing the image reflected from the speculum, and adjusted so as to view it in the most convenient manner. For this purpose, a seat is suspended from the lower edge of the open part of the tube, capable of being raised or lowered about a foot, to accommodate it to different observers. In this the person sits with his head so little above the edge of the tube, as to intercept very few of the rays that fall on the speculum; and as the eye-glass tube is directed towards the focus of the speculum, the image of the object behind the observer is seen at that focus in an inverted position. At the place of observation is a gallery, capable of containing several persons, and as the mouth of the tube is sometimes more than forty feet above the ground, there are ladders and a stair case for ascending to it. The whole apparatus is supported on a strong foundation, consisting of two concentric circular walls of brick capped with stone, on which the instrument is moveable in any direction by means of rollers. The magnifying power of this telescope is so great, that, with proper eye-glasses of very small focal distances, an object appears above 6000 times larger than it would to the naked eye; and hence the surface of the moon and planets is seen to great advantage, and stars invisible to the naked eye are distinctly observed. Sir William Herschel has also constructed smaller telescopes on the same principle, with which the satellites of the principal planets are easily observed, and with one of them he discovered the planet which bears his name. Herschel's telescopes are constructed on the principles of those of Newton, but, when very large, they require no additional mirror.

It is now supposed that, besides their magnifying power, telescopes have a power of penetrating into space, as it is termed; otherwise they could not enable us to discern objects wholly invisible to the naked eye.

*Microscopes.*—As telescopes are employed for viewing distant objects, microscopes are used for examining such as are near, but too minute to be seen distinctly with the naked eye. They are composed of convex or spherical lenses, or of concave mirrors, fitted up so that an object can be steadily viewed in a proper position. Microscopes are divided into single and double, or compound, the former having only one lens or mirror, and the latter more than one.

Single microscopes are constructed with a magnifying lens of glass, or sometimes with a drop of water, or other transparent fluid. For ordinary purposes, a double convex lens, of great convexity in proportion to its size, and fitted in a frame with a handle, so that it may be held in the hand, or screwed to a support, while the object to be examined is held or fixed in its focus, on the point of a needle, or between a pair of pliers, answers very well. The smaller the object to be viewed, the greater must be the convexity of the lens; and for very minute objects, little spheres of glass, fixed between two thin plates of brass, with opposite perforations, rather less than the diameter of the sphere, form excellent microscopes. As the eye must be held at the posterior focus of the lens or sphere, in order to view distinctly the magnified object in the other focus, microscopes formed of very small lenses, are attended with two inconveniences; they fatigue the eye, and the light necessary for distinct vision is diminished; but, in other respects, they are very convenient, as they are easily made, and very portable. Spherules of glass for such microscopes are best formed of good crown-glass, a narrow slip of which, cut from the edge of a pane, is held opposite the flame of a candle, so that it may be melted by the blow pipe. The fused glass drops down and forms a thread, the extremity of which is melted in the blue flame of the candle, till it forms a globule, which, when removed from the stalk, is placed, as already described, between the perforated plates of brass, so that its most perfect spherical part shall be between the two perforations.

It is astonishing how much the apparent magnitude of a minute object, such as a cheese mite, is increased by these small glass spheres, some of which are capable of magnifying above 1000 times. The magnifying power of a single microscope is estimated, by comparing the focal distance of the lens, with the distance at which the same object is usually seen by a good unassisted eye; thus supposing eight inches to be the nearest limit of distinct vision, and that a minute object is viewed through a lens, whose focal distance is $\frac{1}{4}$ inch, or $\frac{1}{32}$ of the nearest distance, the length or breadth of that object will appear increased 32 times, its superficial dimensions 1024 times, and its whole bulk 1,048,576. Now, the magnifying power of a sphere of glass is much greater than that of any portion of that sphere; and the spherules employed for single microscopes, may be made so small as to magnify the diameter of an object above 2000 times.

*Ellis's Microscope.*—A very convenient single microscope, contrived by the late John Ellis, celebrated for his observations on corallines and other zoophites, is represented at Fig. 18. K is a box for holding the several parts of the apparatus, and sup-

Fig. 15.

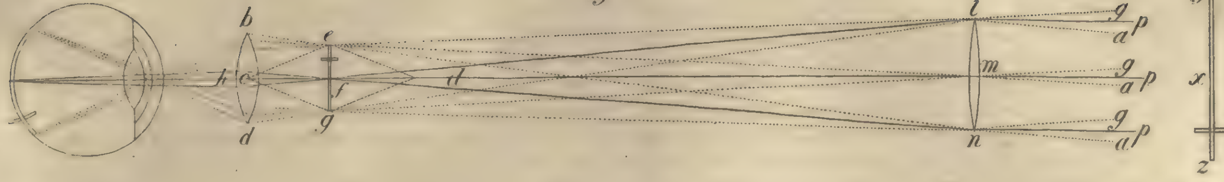


Fig. 16.

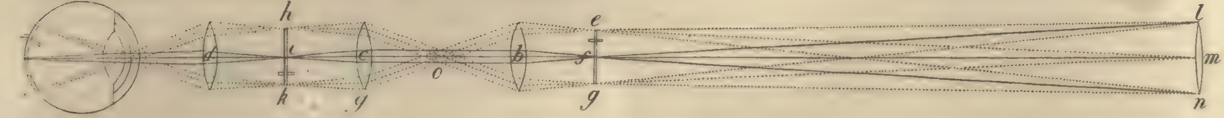


Fig. 17.

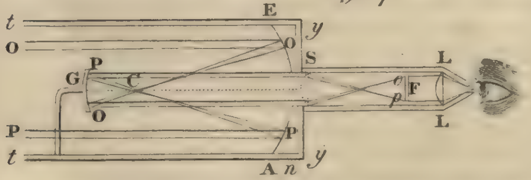


Fig. 18.

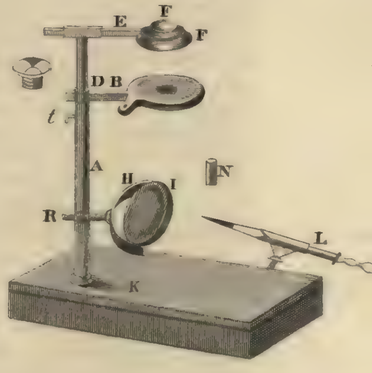


Fig. 19.

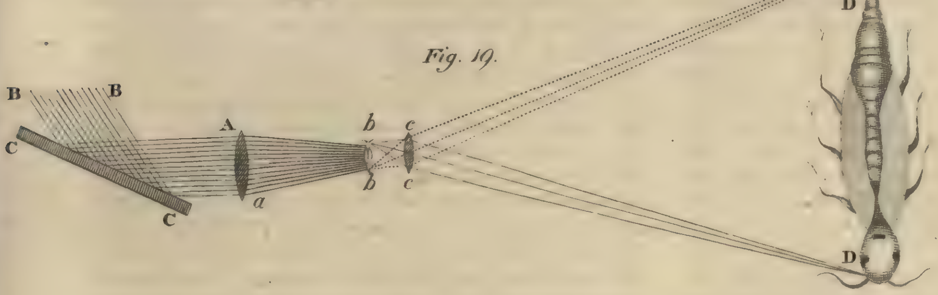


Fig. 20.

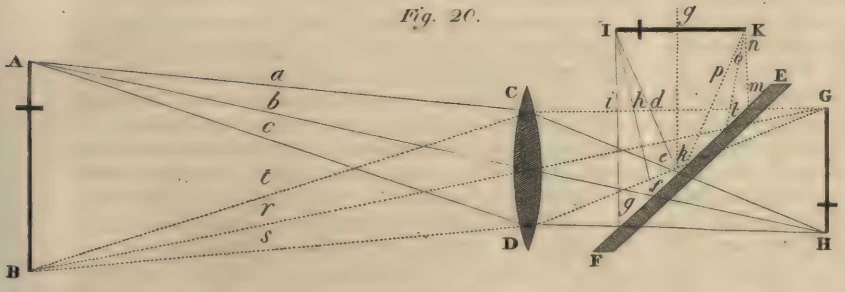


Fig. 21.

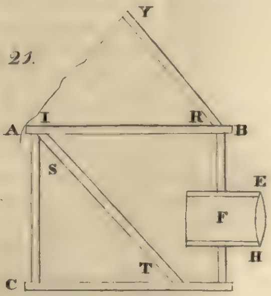


Fig. 22.

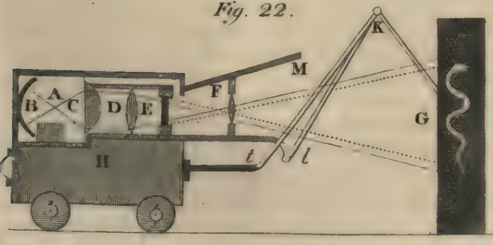
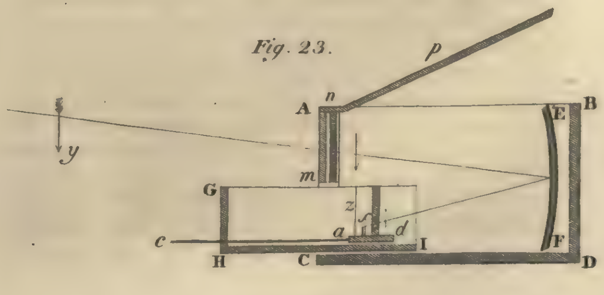


Fig. 23.



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porting them for use. A is a brass pillar that is screwed into a socket at one end of the top of the box, and receives D, a brass pin made to slide up and down within the pillar, and fastened at any height by the screw Z. At the top of the pin is an arm E, at the extremity of which is the magnifying lens, and above it is a metallic speculum, with a perforation in its centre for looking through the lens; while a little below, at B, is a table for supporting the object to be viewed, and fitted to the pillar A by an arm. In this state, the instrument forms a simple microscope, and while the object is magnified by the lens, it is enlightened by the mirror above. Sometimes, besides the upper mirror, another, I, is placed below in the semicircular frame H, and the table is formed of a glass plate, or has such a plate in its centre. Thus the illumination will be increased, and the object will be viewed under more favourable circumstances. L represents a pair of pliers for holding any object that is to be viewed between the glass plate and the lower mirror, and N is an ivory cylinder made to screw on the end of the pliers, for holding such objects as they cannot conveniently contain. This instrument is adjusted for use by screwing in the pillar A, fixing on it by a dove-tail the arm of the table, and fixing the arm carrying the lens and speculum at such a height, by means of the screw Z, as will enable the observer to examine the object properly, whether it be placed on the table, or fixed at the extremity of the pliers, while the lower mirror is moved, so as throw the most favourable light upon the object.

*Wollaston's Periscopic Microscope.*—As in the usual construction of single microscopes, by placing the lens between two perforated plates, the field of vision is much diminished,—Dr Wollaston has introduced an improvement, in what he calls *periscopic microscopes*, to remedy this defect. Instead of a double convex lens, he employs two plano-convex lenses of equal radius, which are placed one on each side of a perforated plate, with their plane surfaces next it. By this separation of the glasses, some light is lost; but as this construction admits of an aperture in the plate, equal to one-fifth of the focal distance of the lenses, that inconvenience is more than compensated by the increased field of vision. Dr Brewster has proposed a remedy for the loss of light in Wollaston's microscope, by filling up the vacancy between the lenses with a fluid of equal density; or, what he thinks preferable, as correcting the aberration of light, by forming an achromatic magnifying glass of two double convex lenses, with a double concave lens, of different refracting power, between them.

A microscope or *megalscope*, as it has been called, which may be rendered either single or compound, is formed of three convex lenses fixed in tortoise-shell rims, and shutting up in the same case,—each side of which has a circular hole opposite the lenses. The three lenses have different focal distances as 1, 1½ and 2 inches; and any one of them may be used singly for magnifying near objects which are not very minute, such as the parts of flowers or insects. When any two of them are used together, they form a compound microscope, of different magnifying power according to the combination of their focal distances; and when they are all used together within the case, so that an object is viewed through their centers, by means of the opposite holes, they form a compound microscope of considerable magnifying power; but, with this instrument, objects cannot be seen very distinctly, from the great thickness of the refracting medium when two or more of the lenses are conjoined.

*Compound Microscopes* are constructed with two or more convex lenses placed in a tube of bone, ivory, or metal, usually with a stand for supporting the tube. When there are two lenses, they are placed at the opposite extremities of the tube,—that at the farthest end, or next the object, being called the object-glass, and that at the other end, next the eye, the eye glass. In this state, the microscope is said to be double, and resembles the astronomical telescope, the section of which, at Fig. 15. will serve to explain its effect. Suppose an object, *y z*, to be placed a little beyond the object-glass *l n*, the rays proceeding from the object will be converged to a focus within the tube, as at *e g*, where they will form a magnified image of the object. Now, if the eye-glass, *b d*, be so situated that the image *e g* can be brought into its focus, it will convey the rays in a parallel direction to the eye, and there they will form an inverted picture of the object, still more magnified, according as the focal distance of the eye-glass is less than that of the object glass. In order to bring the image into the focus of the eye-glass in this microscope, it is necessary to regulate the distance of the object from the object-glass, till the image is seen as distinctly and as much enlarged as possible; and, by this simple method, the instrument may be accommodated to different peculiarities of sight. Thus, for a long-sighted person, the object must be at a distance greater than for ordinary vision; and for short-sighted persons, the distance must be less. The magnifying power of the double microscope is estimated, by finding the magnifying power of each lens, and multiplying together the numbers expressing those powers,—the sum is the magnifying power of the whole microscope. Thus, if the object-glass magnify the diameter of an object six times, and the eye-glass ten times, the whole instrument will magnify the diameter 60 times, and the superficial dimensions of the object 3,600 times.

The principal inconveniences attending the double microscope, in its simplest form, are, that it shews the objects inverted, and possesses but a small field of vision. Both these defects are remedied by introducing a second eye-glass, between the first and the object-glass, in such a situation, as to intercept the rays of light from the object, before they converge into a focus; this third glass is commonly called the *field-glass*. Still farther, to increase the field of vision, and correct the aberration of light, a third eye-glass of smaller focal distance is sometimes placed immediately behind the first eye-glass.

In the best compound microscopes now constructed, the use of reflecting specula, fixed in such a position as to illuminate the object viewed, and sometimes to increase its apparent dimensions, has been introduced with advantage. For more conveniently examining minute objects, several pieces of apparatus are occasionally required, such as stands or small tables, and small meniscus glasses like watch-glasses, which, when single, are used to contain a small portion of any fluid for observing animalcules, &c. and when joined together to include between them minute insects or other objects.

*Solar Microscope.*—A powerful and useful compound microscope is denominated solar, because it can be used only in bright sunshine. Its construction and effect will be understood from Fig. 19. C C represents a plane mirror placed in an inclined position, on the outside of a window-shutter. *A a* is a convex-lens, fixed at one end of a tube that is fastened at a hole in the window-shutter; and *e e* is another lens, at the farther end of a smaller tube that slides within the first. Opposite this last lens is a sheet, or white paper, to receive the magnified image. If a small object, as a minute insect, *b b*, properly secured, be placed near the extremity of the sliding tube, in the posterior focus of the second lens, its image, in a highly magnified state, will be projected on the opposite sheet, or paper, in the following manner: The parallel solar rays incident on the mirror will, if the mirror be properly adjusted, be reflected so as to pass through the lens in the shutter, and, being refracted, will converge to a focus near the situation of the object, on which they will throw a strong light, and, passing by it, will be refracted by the second lens, which is of less focal distance, will be speedily made to cross and diverge towards the sheet, where they will form a large luminous spot, with the magnified image of the object in its diameter D D. It is necessary to remark that, in experiments with the solar microscope, all light must be excluded from the apartment, except what passes through the hole in the window-shutter, and that they succeed best at noon, when the rays of the sun are most vertical. The simple form of this microscope, now described, has received several additions for increasing its magnifying and illuminating powers, and adapting it to the observation of both opaque and transparent objects.

The use of the microscope, under its various forms, is very extensive. By means of it, great accessions have been made to the knowledge of nature, not only by enabling us to examine more accurately, the intimate structure of known animals and plants, but by making us acquainted with many hundred species, either entirely or nearly invisible to the naked eye. Indeed, by its means, almost a whole order of animals, the *infusoria* or animalcules, has been added to zoology. The objects thus discovered or observed are termed microscopic objects; and a particular account of them will be found in the principal writers on microscopes, especially Adams and Baker; see also HELMINTHOLOGY in this work.

*Micrometers* are contrivances for measuring minute distances, especially the dimensions of objects viewed through telescopes and microscopes. In the former, they are used for computing the diameter of the heavenly bodies, and, in the latter, that of near and minute objects. They have been constructed of different forms, and on various principles; but the most convenient and simple are those which can be employed in conjunction with the telescope or microscope. Of this description is Cavallo's micrometer. It consists of a small scale or slip of well polished mother-of-pearl, about $\frac{1}{20}$ of an inch broad, and about the thickness of common writing-paper, so that it may be easily seen through. It is divided by means of parallel lines, scratched on the surface, into equal parts, and every fifth and tenth division is longer than the rest. This graduated scale is placed behind the eye-glass of a telescope, so that its divided edge may cross the centre of the field of view, or the perforated metallic plate called the diaphragm, already described as being usually fixed between the eye-glasses. It may be adjusted to most telescopes, whether refracting or reflecting, provided the eye-glass be convex. In looking through the telescope with this addition, the distant objects will appear to coincide with the edge of the micrometer, and will cover a certain number of its divisions; and when the value of each division is known by the following rule, it is easy to compute the diameter of the observed object. The simplest method of determining the value of the divisions for the heavenly bodies, is to mark how many are covered by such a body when observing it with the telescope, and then to look in the Nautical Almanack for its apparent diameter on that day. The latter number is to be divided by the former, and the quotient will be the value of one division on this micrometer. Thus, if at any particular observation of the sun, that luminary is found to cover 26½ divisions of the micrometer, and its apparent diameter for that day is found to be 31′ 22″ or 1882″, dividing this last number by 26.5, we have for a quotient 71′ or 1′ 11″, which is the value of one division of the micrometer for such objects. Hence it is easy to compute the diameter of any other distant object, by comparing it with the number of divisions intercepted. In a similar manner, when this micrometer is applied behind the eye-glass of a microscope, the lineal dimensions of the objects viewed may be estimated, by first fixing the value of the division of such object, as follows: Let any object of known dimensions, as a piece of paper $\frac{1}{10}$ inch diameter, be placed before the microscope, and the number of divisions it intercepts be marked. If this number be multiplied by the absolute diameter of the object, the product will be the value of one division. Thus, in the present instance, suppose the piece of paper, when magnified, to intercept 50 divisions, each division will be equal to $\frac{1}{500}$ of an inch. Hence, the magnitude of an unknown object may be determined by reckoning how many divisions of the micrometer its image covers, and reckoning for each $\frac{1}{500}$ of an inch.

Dr Brewster has made an improvement on Cavallo's micrometer, by constructing it of a circular form, and dividing the circumference into 360 equal parts, by which means the graduated edge is visible in any position of the instrument. It is fixed in a separate tube between the third eye-glass and the diaphragm at the nearest focus of that glass; and he gives a table for computing the angles subtended by any number of divisions, and thus determining the diameter or dimensions of the object viewed. See Brewster's *Treatise on New Philosophical Instruments.*

Another simple contrivance of this kind, adapted chiefly to telescopes, is to place, within the field of view, pieces of horse hair of a known thickness, either across each other, or parallel to each other, at a certain distance; and this last method appears the best. Wires of very small diameter are now generally substituted for the hairs, and are adjusted at any required distance by means of very fine screws; so that minute lengths, from the 100th to 10,000th of an inch may be observed.

Of the more complex micrometers, for measuring angular distances and diameters of the heavenly bodies, that of Dolland is one of the most convenient. It consists of a small telescope with one eye-glass, and an object-glass cut in halves, with a contrivance for making the divided parts slide by each other, so that the image of such objects may be seen through the centre of each, and the distance between the two centres can be accurately measured. Improvements on micrometers, for various purposes, have been recently made by Dr Brewster, Dr Wollaston, and Sir William Herschel.

*Camera Obscura.*—Baptista Porta's experiment, which suggested the camera obscura or dark chamber, has been briefly mentioned in the history. It is best conducted in the following manner: Suppose C D, Fig. 20. to represent a double convex-lens, having a focal distance of a foot or two, placed in the hole of a window-shutter in a room from which all other light is excluded; and that a white screen or sheet of paper be held within the room, at the focus of the lens: The rays of light, diverging from external objects, as A B, will be received by the lens, and refracted so as to converge at its focus on the screen, where they will form an inverted miniature picture, G H, of the objects, in their natural colours. The picture will be brighter and more distinct according as the light is stronger, and the objects are situated at nearly the same distances; but the experiment will not succeed if the sun be opposite the lens. If a plane mirror, E F, be placed between the lens, and its focus inclined at an angle of 45°; the rays from the lens will be intercepted by it, and reflected so as to throw the picture upwards to I K, where it may be received by a sheet of oiled paper, or a plate of glass, the upper surface of which has been deprived of its polish, by grinding it with sand and water. Under these circumstances, a person looking down on the paper or glass, will see the picture to great advantage, and may trace its outlines with a pencil. This is the most simple form of the camera obscura. But, to construct the instrument so called, a rectangular box is formed, as A, B, D, C, Fig. 21, which may be of various sizes, according as the instrument is to be fixed or portable. Fig. 21. represents one of the latter kind. In the front of the box is placed a sliding tube F, in the outer extremity of which is fixed the convex lens E H, and opposite its inner extremity, within the box, is the plane mirror S T, inclined at an angle of 45°. At the top of the box is the glass plate, roughened on its upper surface, for receiving and copying the picture; and Y is a smooth board inclining over the glass, and furnished with a black curtain for excluding the light. The inside of the board and of the box are also blackened for the same purpose. The box is placed with the lens opposite to the objects or landscape to be observed or depicted, and the observer places his head below the curtain. When not in use, the several parts of the apparatus are contained within the box, which is furnished with a lid for covering the glass plate, or the lid may supply the place of the board Y. This instrument is not only capable of affording much rational amusement in observing fixed or passing objects, but is employed with advantage in drawing, as the rough glass plate may be removed, and the picture drawn on it transferred to oiled paper, by pressing the glass gently on the paper, so as to leave an impression of the strokes of the pencil, and the drawing may be afterwards copied and filled up.

When employed for drawing, the instrument is sometimes composed of two square drawers, one containing the tube and lens, and the other the mirror and rough glass plate, with a lid for forming the shade. Another construction for the same purpose, for taking the picture immediately on paper, is to have the mirror, on the outside of the lens, so placed as to throw the picture downwards, on a horizontal plane; and there are two openings for admitting the head and arm of the draughtsman, without allowing the light to enter. Large cameræ obscuræ, for public exhibition, to several persons at a time, are attached to some observatories, as at Edinburgh, Greenwich, and Glasgow.

*Phantasmagoria.*—This name has been given to an optical exhibition which has excited considerable interest in this country, and in which the appearance of spectres, and other terrific objects, were produced by an apparatus resembling the magic lantern on a large scale. Some account of the exhibition will be expected here. It was contrived by Mr Philipsthal, and was usually conducted in a theatre or a large room, all the lights of which were extinguished except one suspended from the ceiling, which could be drawn up within a chimney so as to leave the spectators in total darkness. Under the gloomy light of this single lamp, the curtain was drawn up, and exposed to view a scene representing a sort of cave, with skulls, skeletons, and other objects of terror, in painting or relievo. When the spectators had time to compose themselves after this view, the lamp was drawn up into its chimney, and the darkness thus produced was only occasionally broken by flashes of lightning, followed by peals of distant thunder; then followed the appearance of various spectres, as the ghosts of departed persons, and especially of celebrated characters, some in whole length and others as busts, and some of them were made to undergo sudden transformations. At first the figures appeared small and obscure, but gradually became larger and brighter, and appeared to advance towards the spectators, and on a sudden to disappear as if they sunk into the ground. No satisfactory description has been given of the apparatus for conducting this exhibition,—but an instrument of a similar nature has been described by Dr Thomas Young in his Lectures, and a section of it is given at Fig. 22. At A is a lamp, the light of which is thrown by the mirror B, and through the lenses C and D, on a painted slider at E, and the magnifyer F forms the image on a screen at G; the magnifying lens is fixed to a slider, which may be drawn out of the box

H, that forms the general support of the whole apparatus. The box moves on wheels or rollers, and when it is drawn back the point K is lowered by the rod I K, and the rod K L adjusts the slider, so that the image is always distinctly painted on the screen. In order to diminish the size of the image and make it finally vanish, the box is rolled forwards towards the screen, and the support of the lens F allows the screen M to fall and intercept part of the light. The rod K N is made equal to I K, and the point I must be at twice the focal length of the lens F before the object L, being immediately below the focus of the lens.

*Walker's Phantasmascope.*—An apparatus for a similar exhibition, but on a simpler construction, and better adapted to private use, is the phantasmascope of Mr Ezekiel Walker, lecturer on Natural Philosophy. It is represented at Fig. 23. and consists of a wooden box, A B C D, 36 inches long, 21 broad, and 22 deep, at one end of which is fixed a concave mirror, E F, 15 inches in diameter. The other end of the box, at *m*, is divided into two parts by a horizontal bar. A *m* is a door that opens to the left side; *n o*, a board with a circular opening ten inches in diameter, and covered with plate-glass opposite the mirror. G H I is a drawer opened at the end I, and covered at G *m* with tin-plate. In the figure it is represented drawn out to the length of 16 inches; *a b* is a moveable stage, 15 inches long, and six broad, sliding freely on the bottom of the drawer by means of a strong brass rod *c a*; *d x* is a partition fixed to the stage 15 inches long, and reaching nearly to the top of the drawer; and near the bottom of the partition is a circular aperture, *x*, three or four inches in diameter; *z a* is a screen seven inches and a-half high and four and a-half broad, covered with white paper on the side next the mirror, for preventing any light that may be reflected from the end of the drawer from passing through the aperture *x*. The cover of the box, *n p*, is represented as drawn up, to conceal the apparatus within. For exhibition, a painting on glass, in transparent colours, is placed against the aperture *x* in the partition opposite the mirror, and two short candles are placed on the other side between *z a* and *d x*. Every part of the glass, except where the figure is painted, must be rendered opaque. Now the light transmitted through the painting falls on the concave mirror, and is thence reflected, so as to form an image of the figure in the air, of brighter colours than the original. In the situation of the apparatus represented in the figure, the image will appear on the outside of the box as at *y*; but if the stage be drawn out to the end of the drawer G H, the figure will appear within the machine, and very small, at *n*. The objects usually exhibited with this apparatus are phantoms and transparent pictures, for mere amusement; but it may be converted to a more useful purpose in imitating the appearances of some of the heavenly bodies. Thus Jupiter and his satellites may be represented as they appear through a telescope, by taking a piece of black paper, about three inches square, and cutting a circular hole near the middle, to represent the planet, with four small holes, made with a circular punch, at various distances in a line with the centre of the large hole for the satellites. This paper is to be pasted on the rough surface of a piece of glass, having the polish removed on that side by grinding, and a few transverse strokes are drawn on the glass with a soft lead-pencil, to imitate the belts of Jupiter. In a similar manner, Saturn, with his ring and satellites, phases of the moon, comets with their tails, and the rising or setting of Mars and the moon, may be imitated with great success. The red colour, exhibited in these last appearances, may be produced by using a screen of paper stained red, which will reflect a similar tint on the object at X, and this tint may be modified by varying the position of the candles.

*Photometers* are instruments for measuring the intensity of light proceeding from luminous bodies, or its comparative intensity from two such bodies as two lighted candles. The most convenient photometers are those of Count Rumford and Professor Leslie. The method of the former is to place two lights, at distances from a given plane, or an opposite wall, that the shadows cast by them may appear equally dark; and as the intensity of light obviously decreases, as the square of the distance increases, it is easy to calculate, from the determined distances, the intensity of the lights thus compared. On these principles Count Rumford contrived an apparatus, which is described in the *Philosophical Transactions* for 1794.

Leslie's photometer is the same as his differential thermometer described under METEOROLOGY, and represented at Fig. 6. Pl. 128. It is constructed on the principle that light, when absorbed by a dark opaque body, produces heat in proportion to its intensity. Hence, when the blackened ball of the photometer is exposed to the light, the air within the tube on that side of the instrument is expanded and drives back the coloured fluid, so as to make it rise in the other tube, and the degree of its elevation is marked by the scale between the tubes, and will be greater according as the light is more intense.

When this instrument is used as a photometer, it must be covered with a glass tube, resting on the stand. It is thus defended from the influence of heat, while it is fully exposed to that of light. In experiments with artificial luminous bodies, as lamps or candles, it is sometimes necessary to place several screens of talc, one before another, between the instrument and the light, to prevent the access of heat. In comparing the intensity of light of two such bodies, it is proper to use two photometers of the same size and scale.

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Option
‖
Oracle.

OPTION, in ecclesiastical affairs, denotes the legal conveyance which every bishop, whether created or translated, is bound to make to the archbishop of the next vacant dignity or benefice connected with the see, and which, as it may be chosen by the said archbishop, is denominated an option.

OR, the French term for gold, which is in heraldry expressed by dots or small lines. The or is blazoned topaz in the coats of the nobility, and sol in those of sovereign princes. See HERALDRY.

ORA, an ancient term signifying an ounce; though whether the ora was a coin, or merely money of account, is not decided by antiquaries.

ORACLE denotes the place where any particular heathen divinity was supposed to give responses respecting matters of importance; or the answer itself, or the god who was imagined to give it. The most ancient oracle was that of Dodona, and the most celebrated that of Delphi, both of which we have already noticed. See DODONA and DELPHI.

The same term is employed in the sacred Scriptures with respect to the ark, or the cover of the ark of the covenant, the sanctuary or the most holy place wherein the ark was deposited; and the Jews, it appears, were favoured with different kinds of oracles, besides that which was *viva voce* received from the Supreme Being by Moses. Such were prophetical dreams, visions, and the oracle of the Urim and Thummim.

Oran
‖
Orange Ri
ver.

ORAN, a maritime and fortified city of Algiers, in the province of Mascara, and almost opposite to Carthagena in Spain, is built on the declivity of a mountain, and has, within a few miles to the east, a spacious bay capable of admitting the most considerable fleets. It is said to contain a population of 12,000, the greater part of which have been banished from Spain. The Mahometans who find refuge here live apart by themselves, and are numerous.

ORANGE RIVER, a considerable river of South Africa, which seems to originate about 30° S. latitude and 28° E. longitude, is subject to great inundations, and has several large cataracts. In its course towards the sea it flows for a number of leagues west by north, between the Great and Little Namaquas, two tribes similar to the Hottentots, and perhaps of the same origin.

**ORATORIO**, a kind of musical drama, designed from Scripture, or from the life of some saint, and containing recitations, duettos, trios, retornellos, choruses, &c. According to some, the oratorio was originally an imitation of the opera, and was introduced in 1515 by San Filippo Neri, a native of Florence, who instituted at Rome the congregation of the priests of the Oratory. But oratorios, properly so called, were not invented till the 17th century. They are still performed at Rome, especially in the church of La Vallicella, on Sundays, from the first of November till Easter. In England, also, oratorios have been recently introduced into the principal theatres.

**ORATORY** has been defined the art of speaking well upon any subject so as to persuade; and in this sense the term bears the same import with rhetoric. See LANGUAGE.

**ORBIT**, the path of a planet or comet, or the curve that it describes in its revolution round its central body. See ASTRONOMY.

**ORCADES**, the Orkney islands,—which see.

**ORCHARD**, a tract of land set apart for the growth of standard fruit trees. For the proper situation of orchards, the soil best adapted, and other particulars, see GARDENING.

**ORCHESTRA**, a certain place set apart, in a theatre or other place of amusement, for instrumental musicians to perform in. In the Grecian theatres, the orchestra was that part of the proscenium or stage where the chorus was to dance; but in the Roman theatres it nearly answered to what we call the pit, as it was entirely occupied with seats for persons of distinction.

**ORDEAL**, an ancient and barbarous mode of trial by fire, water, or other means for the discovery of innocence or guilt; and which, from the presumption of its being an appeal to the Supreme Being, was denominated *judicium Dei*, or *vulgaris purgatio*, in contradistinction to canonical purgation, which was by oath. The ordeal appears to have been known to the ancient Greeks; and particular instances of it in Bithynia, Sardinia, and other places, are noticed by Grotius. Among the Hindoos, however, more than among any other people, it seems to have been prevalent; and from a paper communicated by Warren Hastings, Esq. to the *Asiatic Researches*, they appear to have nine ways of performing it, namely, by the balance, by fire, by hot oil, by images, by poison, by red-hot iron, by rice, by the cosha, and by water. In Europe, fire ordeal and water ordeal, in particular, were at one period practised; the former for the trial of persons of rank, and the latter for that of the common people; and, before both these, preparations were usually made by fasting and religious ceremonies. Ordeal by fire consisted in taking up a piece of red-hot iron of the weight of two or three pounds, or in walking blindfold and barefooted over nine ploughshares, laid lengthwise at equal distances; and ordeal by water was performed either by plunging the bare arm of the suspected person into boiling water, or casting him bodily into a river or pond. In these trials, the escape of the individual from injury was deemed a proof of innocence, and *vice versa*. There were besides these some other methods of trial, especially those of the cross and the corsned. "The judgment of the cross," says Dr Henry, "was commonly thus conducted. When the prisoner had declared his innocence upon oath, and appealed to the judgment of the cross, two sticks were prepared exactly like one another; the figure of the cross was cut on one of these sticks, and nothing on the other. Each of them was then wrapped up in a quantity of fine white wool, and laid on the altar, or on the relics of the saints: after which a solemn prayer was put up to God, that he would please to discover, by evident signs, whether the prisoner was innocent or guilty. These solemnities being finished, a priest approached the altar, and took up one of the sticks, which was uncovered with much anxiety. If it was the stick marked with the cross, the prisoner was pronounced innocent; if it was the other, he was declared guilty. When the judgment of the cross was appealed to in civil causes, the trial was conducted in this manner: The judges, parties, and all concerned being assembled in a church, each of the parties chose a priest, the youngest and stoutest that he could find, to be his representative in the trial. These representatives were then placed one on each side of some famous crucifix; and, at a signal given, they both at once stretched their arms at full length, so as to form a cross with their body. In this painful posture they continued to stand while divine service was performing; and the party, whose representative dropped his arm first, lost his cause." It was usual for the clergy, when accused, to appeal to the ordeal of the corsned. This safe and convenient mode of trial consisted merely in swallowing freely, as a proof of innocence, a piece of barley-bread and a piece of cheese taken from off the altar, after certain conjurations and prayers had been made by a priest, that, if the individual suspected were guilty, God would send his angel Gabriel to stop his throat, &c.

By act of Parliament, 3d Henry III. according to Sir Edward Coke, these barbarous superstitions were abolished in England. The learned professor, Beckmann, in speaking of the trial by ordeal, wherein persons accused were obliged to prove their innocence by holding in their hands red hot iron, says, "I am almost convinced that this also was a juggling trick of the popes, which they employed as might best suit their views. When the ordeal was abolished, and this act rendered useless, the clergy no longer kept it a secret. In the 13th century an account of it was published by Albertus Magnus, a Dominican monk. If his receipt be genuine, it seems to have consisted rather in covering the hands with a kind of paste than in hardening them. The sap of the *althaea*, marshmallow, the shining seeds of the flea-bane, which is still used for stiffening by hatmakers and silk weavers, together with the white of an egg, were employed to make the paste adhere; and, by these means, the hands were as safe as if they had been covered with gloves." Besides the methods of trial now described, there is another particularly worthy of notice, namely, that by wager of battle. See BATTEL, trial by, and DUEL.

**ORDER**, in architecture, applies to such a portion of a particular building as comprehends its entire design. For an account of the five different orders, namely, Doric, Ionic, Corinthian, Tuscan, and Composite, see ARCHITECTURE.

ORDER, in astronomy, the particular direction of the motion of a planet, in reference to the fixed stars. A planet moves according to the order of the signs, when it proceeds through Aries, Taurus, Gemini, &c. towards Pisces; and contrary to the order of the signs, when its motion is in a retrograde direction, as from Pisces to Aquarius. See ASTRONOMY.

ORDER, in geometry, applies to those lines which can be expressed by equations of the same number of dimensions, when they are said to be of the same order; whereas two lines requiring equations of dissimilar dimensions are considered lines of different orders. Thus, the order is named from the rank or order of the equation by which the line is expressed; the simple equation or first power denoting the first order of lines, which is a right line; the quadratic equation or second power defining the second order of lines, which are the conic sections and circle; the cubic equation, or third power, the third order of lines, &c.

ORDINANCE, or ORDONNANCE, a statute or order of a sovereign or superior. According to Sir Edward Coke, the difference between an ordinance of Parliament and an act, is, that the latter can only be made by the king and the threefold consent of the estates, while the former may be made by one or two of them.

ORDINARY applies to any judge who, in his own right, can take cognizance of civil causes, not by deputation, but as a magistrate. In the canon law, an ordinary is one who has immediate authority in ecclesiastical causes; in which sense the appellation belongs to archdeacons, though more decidedly to the bishop of the diocese.

ORDINATES, in geometry, right lines drawn parallel to each other, and which cut the curve in a particular number of points. They are generally all intersected by another line, called the absciss; and the property of the curves is most remarkable when this line is a diameter of the curve, because, in curves of the first order, or the conic sections and circle, the ordinates are all bisected by the diameter; and in those of the second order, which may be cut in three points by an ordinate, those of the three parts of the ordinate lying between these three intersections of the curve, and the intersection with the diameter, the part on one side of the diameter is equal to the sum of the parts of it on the other side. See MATHEMATICS.

ORDINATION, the solemn act of initiating individuals into holy orders by prayer and the laying on of hands. In the Church of England, the form of ordination is contained in the Book of Common Prayer, and it is authorized by 5 and 6 Edw. VI. c. 1., 8 Eliz. c. 1.; by art. 6. of the Thirty-nine Articles; by the 8th canon; and by the act of Uniformity, 13 and 14 Car. II. c. 4. The bishops, as a mark of spiritual sovereignty in their diocese, have, from the earliest times, enjoyed the prerogative of ordination. There being no bishops in the establishment of Scotland, the presbytery have the sole power of ordaining such as are set apart for the service of religion. See CONSECRATION.

ORDNANCE is a term comprehending all the larger kinds of fire-arms employed in war, both by sea and land; whereas by artillery is only meant such as are used in the land service. See WAR.

ORDNANCE, OFFICE OF, an office for the superintending and disposing of all the instruments and utensils of war in all the magazines, garrisons, and forts in Britain, and which is kept within the Tower of London. The master-general of this important establishment has under him a lieutenant-general, a surveyor-general, a clerk, a store-keeper, a clerk of the deliveries, together with a treasurer, and various inferior officers.

ORES, the mineral substances from which metals are extracted. See CHEMISTRY, GEOLOGY, and METALLURGY.

ORESTES, in mythology, the son of Agamemnon and Clytemnestra, and constant friend of Pylades, who revenged the death of his father by slaying his mother, and likewise Ægisthus, and removed from the Chersonesus the statue of Diana. He afterwards reigned at Argos, married Hermione, daughter of Menelaus, and ultimately died in Arcadia in consequence of the bite of a serpent. The friendship of Orestes with Pylades, who received his sister in marriage, was such as to become proverbial, and to both these friends divine honours were paid by the Scythians.

ORGAN, from ὀργανον, an instrument or machine of any kind; in which sense, the tongue has been called the organ of speech, the eye of seeing, and the lungs of respiration, and hence also the arteries, bones, and muscles; and even the mechanic powers, as productive of certain operations, may be denominated organs.

ORGAN, an instrument of music, so termed by way of excellence, as being the largest and most harmonious of all wind instruments, and in the structure of which has been displayed the greatest ingenuity. This instrument is of the highest antiquity, although but little is to be learned concerning it from the description that Vitruvius has given of it.—For the knowledge of this grand instrument the Latins were indebted to the Greeks; and St Jerome mentions one at Jerusalem, the sound of which could be heard at the mount of Olives, and another having twelve pair of bellows, that was distinctly audible at the distance of 1000 paces.

An Italian priest is said to have been the first who introduced the use of this instrument into France in 815, although it has been alleged that it was known in that kingdom so early as the days of Charlemagne, or perhaps of Pepin. Many opinions have prevailed respecting the time when the organ was first introduced into the service of the church. Ammonius and some others maintain, that it was in the time of Louis the Pious, about 820; while Bellarmine and others contend it was not till 50 years after that period. The learned Bingham, in his *Origines Sacrae*, affirms, that it was the general opinion of the learned in his days, that organs were not invented till after the time of Thomas Aquinas, A. D. 1250. It seems, however, to be generally agreed that they were introduced into the church in 666, by Pope

Vitalian, and that about the beginning of the ninth century they were in general use all over Europe. During the civil wars in England in the seventeenth century, a strong prejudice arose against the use of organs, so that they were removed out of all the churches; and so general was this reprobation, that, at the time of the restoration, scarcely an organ builder or organist could be found. In the church establishment of Scotland, organs have never yet been adopted; and although an attempt, about 12 years ago, was made to introduce them at Glasgow, it entirely failed. They have long been in use, however, among the Presbyterians in Holland, where the same form of church government prevails as in Scotland and they are likewise in use in the Scotch church of Calcutta, which is under the jurisdiction of the Presbytery of Edinburgh.

Mouth Organ.—The great antiquity of the mouth organ, which is well known under the appellation of *Pan's Pipes*, has been fully established. This instrument may be observed on many ancient coins, relating to music and to the fabulous deity Pan, who is usually represented with his "pipe of unequal reeds in one hand and his shepherd's crook in the other." From the simplicity of its construction, the mouth-organ appears to be of much higher antiquity than can be traced; and it may perhaps excite no small surprise in some minds, that the existence of the great organ many centuries before the Christian æra is indisputable. The masnakitha of the ancient Hebrews was an instrument apparently of this kind, being composed of various pipes, fixed in a chest, but open above, and closed at the bottom, where there were small perforations, communicating with a wind tube into which the performer blew, while he stopped with his fingers those pipes that were not required to sound. In this simple instrument perhaps originated the invention of the great organ, which, by numerous and successive improvements, has at length arrived at such perfection. Plato, and his commentator Proclus, likewise mention a similar instrument among the Greeks, called Panarmonium, and so constructed that each opening was capable of producing at least three different sounds, and which, although rude, bears a striking resemblance to the modern organ.

Hydraulicon, or Water-Organ.—This instrument was so constructed that it admitted of being blown by means of water instead of bellows, and hence the origin of its name—the hydraulic organ. This organ seems to be an improvement upon the former, or upon the clepsydra or water-clock of Plato, which played the hours of the night upon flutes, when they could not be seen; and the invention, or rather improvement, has been ascribed to Ctesibus of Alexandria, a barber; but as to its construction we can discover nothing more than that it had numerous pipes into which the wind was impelled by a fall of water. One author has inferred, that the air was compressed by the power of water, as in the air vessels of the fire-engine; but as the ancients were altogether unacquainted with the principles of pneumatics, this account does not appear to be completely satisfactory. The air-pump, indeed, was not discovered till 1654, when its inventor, Otto de Gueriche, exhibited his experiments before the emperor and states of Germany; nor was the fire-engine known till 1721, when it was invented by Zachary Greyl. It seems probable that the air was acted upon by a cataract or stream of water falling down a long tube or pipe, dashing on a stone at the bottom, whence the air thus drawn down rushed into the apertures with a violent current. But in whatever manner this organ may have been constructed, certain it is that the sounds proceeded from some hydraulic apparatus. Both Vitruvius and Archimedes have given descriptions of this kind of organ; but the precise nature of its construction has never been perfectly understood, even although the ancient remains of this piece of musical mechanism are not unfrequently to be met with in the vineyards of Italy. Dr Burney informs us in the account he has given of ancient instruments of music, that there is a fine representation of the hydraulic organ on the reverse of a large and beautiful medallion of Valentinian, in the cabinet of antiquities bequeathed to the Vatican by Christina, queen of Sweden, which represents one man on the right, and another on the left, pumping the water which plays the organ, and seeming to listen to the sound. It is placed on a round pedestal, and has only eight pipes, and the motto or inscription upon it, which is perhaps erroneously copied, is PLACEA SPETRI.

Pneumatic Organ.—This modern instrument, blown by bellows, being of modern date, was probably only an improvement upon the former. It may be considered rather as a collection of many musical instruments, so ingeniously constructed that the performer can, according to his taste and pleasure, produce a vast variety of effect, by combining several, or all, or by playing singly on one. The grand and almost endless variety of effect which this complicated piece of mechanism is capable of producing, under skilful hands, is truly wonderful.

Organs are of various sizes,—some of them remarkably large, and whose powers are immense, causing even the largest cathedrals to vibrate sensibly with their sounds. The size of an organ is generally expressed by the length of its longest pipe. The organ, in the cathedral church at Ulm, is of very great height; it is 28 feet broad, has 16 pair of bellows, and its largest pipe is 13 inches in diameter. Murphy, in his third vol. of Essays, furnishes us with an account of several organs in Germany, and the largest pipe of the manuals of any of these is 16 feet, and of the pedals 32. In Dr Burney's history, it is said that the organs of Germany, in magnitude, and the organists in abilities, seem unrivalled in any other part of Europe, particularly in the use of pedals.

A minute description of the structure of an instrument so very complex as the organ would be of little use, and could afford but little satisfaction to ordinary readers; but we shall endeavour to give such a general outline as will be sufficient to explain the principal parts of this majestic and noble instrument. The wind-chest, which requires to be very closely fitted, is an horizontal box of certain dimensions, which must be perfectly wind-tight, and capable of retaining all the wind impelled into it by numerous and powerful bellows. The quantity and power of the wind it contains, is denoted by the rise or fall of an index. Proportioned to the size of the pipes, are several lines of apertures in the top of the wind-chest; and as the size and interior construction of all the pipes in each row are different from one another, they, consequently, are productive of very different sounds, and those of the bass notes are produced by the largest pipes. Each row, being termed a stop, has a plug peculiar to it, operating upon a slide, and shutting or opening the whole of that row; and this receives the name of *register*. Some organs have more and others fewer stops, in proportion to the rows of apertures or registers. There are valves which prevent the wind from escaping out of the wind-chest into the pipes, till the performer opens them by pressing the keys respectively, when, by communicating wires, the valves are pressed down and the wind fills the pipes; but no sooner is the finger removed from the key, than the valve again shuts by means of a spiral wire-spring, and the sound of that pipe is instantly stopped. Church organs, in general, have several rows of keys, so that more or fewer pipes may be filled, and thus the power of the instrument may be reduced or enlarged at the pleasure of the performer.

Organ-pipes are of two kinds, mouth-pipes and reed-pipes. Mouth-pipes, although formed all on the same principle, yet vary in shape, consist of wood or metal, and are generally constructed either of four plane boards, closely united, and forming a right-angled tube, or of a cylindrical metal tube, whose mouth is formed by flattening a portion of the cylinder. In reed-pipes, the reed consists of a conical tube, or brass cylinder, having a longitudinal aperture in front, on which a brass slip or tongue lies, and by its vibrations causes the sound. Pipes of mixed metals are the best adapted to the higher notes, and are chiefly composed of lead and grain tin; their length and diameter increases in proportion to the note; but metal pipes being inapplicable for all the lower notes, square ones are substituted in their place. All the pipes of an organ have their dimensions regulated by a scale, which is various for organs of different dimensions. Organs receive the name of 8, 12, and 18 feet organs, according to the length of the chief wooden pipe. It may be proper to describe the various kinds of stops, or scales of pipes, made use of in organs. The fundamental stop is the open diapason, which is chiefly a metallic stop, and in which all the pipes are open at the top. The stopped diapason, which, in unison with the open diapason, is always of wood, up to middle C, but above that metal, which is preferable to wood in that part of the scale: the bass notes are stopped at their summit with wooden plugs. The dulciana is a metallic stop, likewise in unison with the diapason. It is voiced reedy in the tone, and extremely soft, and is generally included in the swell. The principal is the middle stop, and, when tuned, is used as the basis for tuning all the other parts, and is likewise a metallic stop. The twelfth is so called from being an octave and a half, or a twelfth above the diapason. The fifteenth derives its name from the double octave above the diapason. It is also metallic throughout, and is voiced fully softer than the principal. The sesquialtera is composed entirely of open metallic pipes of four ranks, speaking from the same wind, tuned in the parts of the common chord, and the upper part is frequently denominated the cornet. The furniture stop is extremely shrill, and in some passages has a beautiful effect. The trumpet, which is a metallic stop, is in unison with the diapasons, goes throughout the scale in large organs, but frequently not lower than middle C in smaller ones; its peculiar tone is produced by what is termed a reed, although in reality a piece of brass, on which the wind acts with great force, and producing a roughness of sound, which is altered still farther by the pipes of this stop all having bell mouths like trumpets. The clarion, or octave trumpet, which is only used in a full chorus, and when great brilliancy is required, is a reed stop also, and an octave higher than the trumpet. The tierce, which is very shrill, and a third above the fifteenth, is used only in the full organ. Except in the full organ, the octave above the twelfth is too shrill to be of any use. The cornet is voiced as loud as possible, and is a treble stop. The dulciana is so called from the peculiar sweetness of its tones. The flute, which is of wood up to one foot C, is voiced soft, and in unison with the principal. The bassoon, cromorna, vox humana, and oboe stops, are all in unison with the diapasons, and derive their names from the instruments which they imitate.

So far as relates to the situation of the keys, the fingering of the organ is exactly the same with that of the piano-forte; but great experience and taste are requisite for the proper adaptation of the various stops, either in accompanying a choir, or in the performance of sacred music.

The church organ consists of the main body, or what is called the great organ, and the positive, or little organ. To give the reader an accurate idea of the church organ, its several parts are represented in Plate 146.

HIH, Fig. 1. represents the sound-board, which is composed of two parts, the upper board or cover HH H, and the under HI, which is much thicker than the other; each of these consists of several planks joined very close together. In the under side of the lower board are several channels, which run in the direction LL, MM, &c. and are continued as far as there are stops in the organ. These channels are covered over very close with parchment or leather, except a hole at the fore end next HK, upon which is placed a valve or puff. These channels are called *partitions*. When this valve or flap is shut, it keeps out the air, and admits it when open. On the upper side of the lower board are likewise several broad square channels, across the former, but not so deep as to reach them; these lie in the direction LN, PQ, &c. To fit these, there are the same number of wooden sliders or registers *f*, *f*, *f*, &c. running the whole length; and these may be drawn out or thrust in at pleasure. The number of these is the same as the stops in the organ. IKKK is the wind-chest, which is a square box fitted close to the under side of the lower board, and made air-tight, so that no air can get out but what goes through the valves along the partitions. VV are the valves which open into the wind-chest. One of these valves, with the spring that shuts, and the wire that opens it, is represented by Fig. 2. C, D, E, F, &c. are keys on which the fingers are placed: these lie over the horizontal bar of wood W, in which are stuck an usual number of wire-pins *z, z,* on which keys may be fixed; and the keys move up and down on the ear, as on a centre. There is another bar, against which the keys fall when put down, marked 3: on this also are several wires, which go through the keys to guide them; and on this bar a list is fastened to hinder the keys from knocking against the wood. The keys are made to communicate with the valves several ways. First *s, s, s,* are the key-rollers, moving on the pivots *t, t*; these rollers lie horizontally, one above another, and reach from the valve to the key; *a, a, a,* are arms or levers fixed to the key: *w, w,* the valve wires fixed to the arms *a, a,* and to the valves V, and go through the holes *h, h,* in the bottom of the wind-chest: *b, b, b,* are likewise arms fixed to the key-rollers: *d, d, d,* the key-wires, fixed to the arms *b, b,* and to the keys C, D, E. When the end of any one of the keys is put down, it pulls down the arm *b*, by the wire *d*, which turns about the roller *s* with the arm *a*, that pulls down the wire *w*, which opens the valve that is shut by the spring as the pressure is taken off the keys. Another method of opening the valve is thus: *x y, x y,* are slender levers, moveable on the centres 1, 1; 5 *x*, 5 *x*, are wires going from the further ends of the keys to the ends *x* of the levers; *y* V, *y* V, are other wires, reaching from the ends *y* of the levers, through the holes *h*, to the valves V. Putting down the key C, D, &c. raises the end 5, which thrusts up the end *x* of the lever, by the wire 5 *x*: this depresses the end *y* of the lever, which pulls down the wire *y* V, and opens the valve V. A third way of opening the valves is this: At the end of the key *b*, is a lever 8, 9, moving in the centre 7. With the key, this makes a compound lever. From the end 9, a wire goes to the valve. Putting down the end 6 of the key raises the end 8, which depresses the end 9, of the lever; 8, 9, pulls down the wire, and opens the valve. R, R, are the rollers to move the sliders, by help of the arms *c f, c f,* which are fixed horizontally in these rollers: *k e, k e,* are also levers fixed in the rollers; *l e, l e,* are handles, which pass through the holes *l l*; they are fastened to the lever *k e*, being moveable about a joint at *e*. Handle *l p*, drawn out, pulls the end *e* toward *l*, which turns about R *k*, along with the arm *c f*; and the end *f* pulls out the slider *f g*; and when *p* is thrust in, the arm *c f* likewise thrusts in the slider *f g*. The pipes of an organ are of two kinds; the one has a mouth like a flute, the other with reeds. The first, called *pipes of mutation*, consist, (1.) of a foot AABB (Fig. 3.) which is a hollow cone: (2.) To this foot is fastened the body of the pipe BBDD. Between the foot and the body of the pipe is a partition FEF, that has a long but narrow aperture; over which is the mouth BBC, whose upper lip C, being level, cuts the wind as it comes out. The pipes are of pewter, of lead mixed with a twelfth part of tin, and of wood. Those of pewter are always open at their extremities; their diameter is very small, and their sound very clear and shrill. Those of lead mixed with tin are larger; the shortest are open, the longest quite stopped; those of a mean size are partly stopped, and have besides a little ear on each side the mouth, to be drawn closer or set further asunder, to raise or lower the sound. The wooden pipes are square, and their extremity is stopped with a valve or tampion of leather. The sound of the wooden and leaden pipes is very soft; the large ones stopped are commonly of wood, the small ones of lead. The longest pipes give the gravest sound, and the shortest the most acute: their lengths and widths are determined by a fixed proportion to their sounds; and their divisions are regulated by a rule, which is called the *diapason*. The longest has commonly 16 feet; but in very large organs it has 32 feet. A reed-pipe consists of a foot AABB (Fig. 4.) that carries the wind into the shallot or reed CD, which is a hollow demicylinder, fitted at its extremity, D, into a sort of mould by a wooden tampion G. The shallot is covered with a plate of copper KKLL, fitted at is extremity II, into the mould, by the same wooden tampion. Its other extremity KK is at liberty: so that the air entering the shallot makes it tremble or shake against the reed; and the longer that part of the tongue II, which is at liberty, is made, the deeper is the sound. Lastly, in the mould is soldered the tube HH, whose inward opening is a continuation of that of the reed: the form of this tube is different in different ranks of pipes. The degree of acuteness or gravity in the sound of a reed pipe, depends on the length of the tongue, and that of the pipe C K, taken from the extremity of the shallot to the extremity of the tube. In Fig. 1. X represents a flute-pipe of wood, Z a flute-pipe of metal, Y a trumpet-pipe of metal. The pipes, to prevent them from falling, pass through holes made in boards, placed upon the upper board. The pipes are made to communicate with the wind-chest. To every large organ there must be at least two pair of bellows, which are marked in Fig. 1. by TU, TU. O, O, are the handles, moving upon the axis *n n, n n*. Each of these bellows consist of two boards, the lowest of which is immoveable; and in this there is valve *r*, opening inwards, and a tube leading to it, called the *conveying tube*. There is also a hole in this under board, from which a tube leads to the port-vent, which is a square tube marked 4, rising upward, and inserted into the under side of the wind-chest at 2. Now the handle O being pulled down, raises the upper hoard T, and the air enters through the valve *r*; and when the handle is let go, the weight of the upper board drives the air through the port-vent to the sound-board: and as the bellows work alternately, one pair is constantly descending, which occasions a continual blast through the port-vent. In chamber-organs there is but one pair of bellows; but they are formed of three boards, in the manner of a smith's bellows, and so have a continual blast. In every organ the number of partitions LL, MM, &c. there are in the sound-board (Fig. 1.) that of the valves VV, that of the rollers *s s*, or of the levers *x y* or 8 9 and their wires, and that of the keys ABC, &c. must be always equal. Large organs have 4 or

Fig. 3.

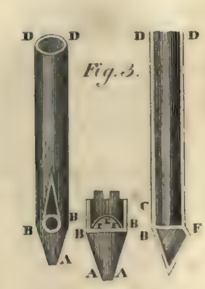


Fig. 1.

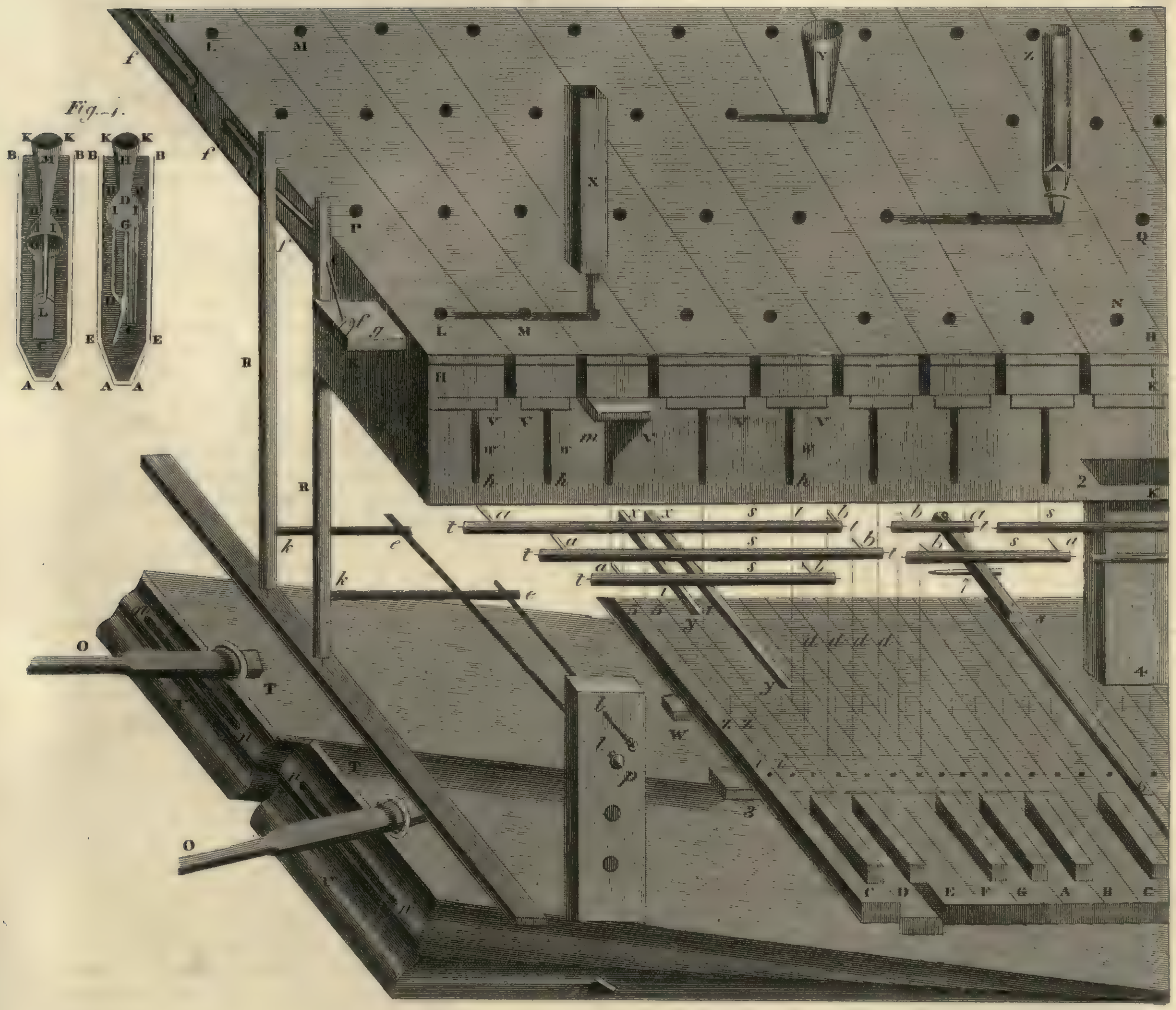
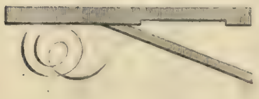


Fig. 2.



5 sets of keys, besides those that belong to the pedals or large pipes, the stops to which are played by the feet. These command certain pipes, which, to increase the harmony, are turned below the diapason. The keys of an organ are usually divided into four octaves; which are, the first sub-octave, second sub-octave, middle octave, and first octave. Each octave is divided into 12 stops or frets, of which 7 are black, and 5 white; the former mark the natural notes, and the latter the artificial notes, that is, flats and sharps. The number of keys, therefore, when there are 4 octaves, must be 48. The pedals have 2 or 3 octaves, at the option of the organist; so that the number of stops is indeterminate. The keys are placed between GG, (Fig. 1.) but the figure could not contain them all. There are also as many handles *l*, *l*, &c. rollers RR, &c. sliders *f*, *f*, &c. as there are stops upon the organ; and between the sliders *f*, *f*, &c. there are as many sliders on the right hand, and the same number of handles and rollers, and other rows of pipes placed between LN, PQ, which could not be expressed in the figure. The least pipes and partitions are placed toward the middle of the organ, and the greatest on the outside. The stops of an organ have various denominations, according to the sounds they are to produce. The foreign organs, especially those of Germany, have many stops: particularly that in the abbey church of Weingarten, a town in the upper Palatinate, which has 66 stops, and contains no fewer than 6666 pipes. The organ at Haerlem is said to have 60 stops, distinguished by names that express the sound which they produce. When this magnificent instrument is played, the handle O of the bellows is first put down, which raises the upper board T, and gives room for the air to enter by the valve *r*. Then the other handle O is put down: in the mean time the board T, belonging to the first handle, descending, and shutting the valve *r*, drives the air through the other valve, up the port-vent, and into the wind-chest. Then drawing out any handle, as that of the flute-stop *p l*, which draws out the slider *f g*, all the pipes in the set LN are ready to play, as soon as the keys C, D, E, &c. are put down. Therefore, if the key D be put down, it opens the corresponding valve *m* V, through which the air enters into the pipe X, and makes it sound. In the same manner any other pipe in the set LN will sound when its key is put down; but no pipe, in any other set, will sound till the slider be drawn out by its corresponding handle.

The swell is an invention of modern date, which enables the performer to produce regular ascendos and diminuendos. It consists of a number of pipes inclosed in a kind of box of thick wood, very close, in a remote part of the instrument, which, being gradually opened by the pressure of the feet, augments or suppresses the sound at pleasure. Messrs Flight and Robson of London have improved upon the swell, the front of which is constructed of very thick boards, each of which, being five or six inches in breadth, is made to move on an axis in the middle of its breadth, and, from its resemblance to Venetian window-blinds, is called the Venetian swell. Messrs Wood and Small of Edinburgh have adopted something of the same kind, but their swells move on an axis at the upper edge, and do not overlap each other, neither are the edges bevelled away. The swell usually consists of seven stops. The tremblant is likewise among the modern improvements of the organ, and is a contrivance for checking the wind by means of a valve in its passage from the wind-chest, and for admitting it only by starts, so that the notes seem to stammer in a way very offensive to the ear, and the whole organ to sob.

EUHARMONIC ORGAN.—The ordinary scale of the organ and other keyed instruments being fixed, and having only twelve sounds within the octave, is very imperfect. The euharmonic organ is a late invention of a Scotch clergyman, the Reverend Henry Liston of Ecclesmachan, to remedy this imperfection, by supplying a great number of additional sounds within the octave, and enabling the performer to vary his scales, so as to produce at all times perfect harmony. In the article MUSIC, § 11. we have explained one imperfection, that the same sound must stand for G♯ and A♭, &c. &c. The first step to the perfection of the scale is to supply two sounds for each finger key. This was the invention of the celebrated Dr Robert Smith, master of Trinity College, Cambridge, and is adopted in the euharmonic organ. By means of a pedal, which shifts a register or slide, the pipes G♯ C♯ are shut, and in their place A♭ D♭, are opened; by another F♯B, are shut, and G♭, C♭ opened; by a third E, A, are shut, and F♭, B♭♭ are opened;—these are called the extreme flat pedals. After the same manner, by one pedal E♭ and B♭ are shut, and D♯ A♯ opened; by a second F, C, are shut, and E ♯ B ♯, are opened; by a third G, D are shut, and F × C × opened;—these are called the extreme sharp pedals. The third extreme flat, and third extreme sharp pedals, however, have been omitted; and this variable scale then consists of 20 sounds within the octave.

This scale, however, is still far from being perfect. If to any note C, we tune G as fifth perfectly exact, and then to G tune *d* fifth perfect also: and taking D octave below *d* tune A, and thence *e* quite exact, and E octave below the last,—we shall find that the A and E are both considerably too sharp as sixth and third to C. In common tuning, therefore, the series of fifths is tuned all somewhat too flat, so as to arrive at A and E tolerably in tune to C. This is called the temperament of the scale. Now, instead of tempering the scale, in the euharmonic organ, all the intervals are made perfectly in tune to C. But, in consequence of this, the fifth between the second and sixth of the scale is greatly too flat, as well as the minor third between the second and fourth of the scale. In this instrument there is therefore another second, flatter than the other, which may be occasionally substituted; which new second is perfectly in tune with the 6th and 4th of the scale. This additional note would be quite sufficient were the music to continue always in the key of C. But, in the great variety of modulation requisite in modern music, the number of additional notes necessary to make the harmony always perfect is very great. In the organ in the Scottish church at Calcutta, built under the direction of Mr Liston, there are 39 notes within the octave, so that this may be considered by far the most perfect instrument of the kind at present in use. The changes are effected by means of four pedals in addition to those formerly described. For a full account of the principles of the instrument, we refer to *Liston's Essay on Perfect Intonation*, or to an abstract of his doctrines in the article MUSIC, in the Edinburgh Encyclopædia, Chap. 12.

The BARREL-ORGAN is an instrument constructed without keys, and played on by machinery. It is formed on the same principle as that already described, but with barrels on which are a great number of small pegs and staples of flat brass wire, of various dimensions, disposed on the surface of the cylinder. When the barrel is turned with an equable motion by means of a crank, the pegs or staples keep open the valves of the pipes in the wind-chest during the time each pipe should speak, according to the duration of the notes which each of them govern. Barrels or cylinders of this kind generally are made to play from ten to fifteen tunes, and can be shifted at pleasure. While turning the barrel the crank also works a pair of bellows to supply the wind-chest.

The BIRD-ORGAN is a very small instrument, whose notes are remarkably soft and melodious, like those of the flageolet, and consists of a couple of octaves or sometimes less, and the whole machinery is contained in a box about the size of a small mahogany tea-chest. This delicate musical apparatus is commonly made use of for teaching bull-finches, canaries, and other musical birds to sing popular airs.

Organs have likewise been so constructed as to be played either by barrels or by the fingers. The most ingenious instrument of this kind that has perhaps ever been constructed is the Apollonicon, which has long been exhibited in London. The external height of this grand and complicated piece of mechanism is 24 feet, its depth 15 feet, and its width 19 feet. It contains three cylinders or barrels, of two feet in diameter each, the length of two of them being eight feet and the other four. Different organs are here combined, so as to give the accompaniments in the scale in their true place. In this instrument are 46 stops, which are applied to the same number of keys from the barrels, by which a combination or change of stops is instantaneously commanded, producing all the effects of numerous musical instruments, as the music may require. The Apollonicon may be played upon with the fingers by five performers, as it contains five key-boards or sets of finger-keys. The effect thus produced by a proper distribution of the music in parts is peculiarly striking and grand. By this means the effects of oboes, flutes, clarionets, horns, trumpets, bassoons, and other instruments, may be produced.

ORGANIC REMAINS, the remains of vegetables and animals, which appear in particular classes of solid rocks, and likewise in alluvial strata. See GEOLOGY.

ORGANICAL, in the ancient music, applied to that part performed by wind instruments, as trumpets, flutes, hautboys; by stringed instruments, as lyres, lutes, harpsichords, and violins; and likewise by drums and such other instruments as are beat with the hands or sticks.

ORGANICAL is a term applied to the description of curves upon a plane, and commonly in a continued motion, by means of instruments. That of a circle, by means of a pair of compasses, is the simplest construction of this kind; and, next to it, is that of an ellipse, by a thread and two pins in the foci, or the ellipse and hyperbola by proper compasses.

ORGANZINE, a particular kind of silk indispensable to the manufacturer, and which is generally imported from Italy. This country is indebted for its introduction to the exertions of Messrs Thomas and John Lombe, the latter of whom, notwithstanding the greatest jeopardy, persevered in taking an exact plan of the complicated apparatus employed in throwing it, in the dominions of the king of Sardinia; and a set of mills for the purpose were, in consequence, commenced in the town of Derby. In 1718, a patent for 14 years was granted to Sir Thomas Lombe, by which he was to enjoy, for that period, the sole right of working organzine; and circumstances having, in 1731, induced him to pray Parliament for the indulgence of a further term, he received a grant of L.14,000, on condition that an exact model of the machinery should be taken and deposited in the Tower of London as a matter of national interest. The working of organzine has at length succeeded in this country, and is carried on to a great extent.

ORGIA were festivals celebrated principally by women every third year in honour of Bacchus, and which were first instituted by Orpheus, and thence called Orphica. See BACCHANALIA.

ORGUES, in fortification, are long thick pieces of wood, pointed and shod at one end with iron, and hanging clear of each other by ropes, all of which pass round a windlass situated over the gateway of a strong place, in order to be let fall perpendicularly on the approach of the enemy, and thus prevent their effecting an entrance. The orgues are evidently of greater utility than the portcullis, because, if a petard break one or two of them, the vacancy may be immediately filled up. The same term applies to a machine made up of a number of harquebuss or blunderbuss barrels properly bound together, and mounted on a stock resembling a swivel gun, with the view of defending breaches that are attacked, by several explosions being occasioned at the same instant, through the medium of one common lock.

ORIBASIA, a genus of plants belonging to the Pentandria class, and of which there are six species indigenous to the milder parts of America.

ORICHALCUM, or AURICHALCUM, a metallic substance, probably similar to our brass or pinchbeck. It was familiar to the ancient Romans, and, though of inferior value, had somewhat of the appearance of gold.

ORIENT, or Port L'ORIENT, is the principal place of a district and seat of a tribunal in the department of Morbihan in France, with a population of 19,922.

ORIGEN, surnamed *Adamantus*, was a native of Alexandria, and one of the most eminent men of the primitive church for learning and fortitude during the third century. To his father Leonidas, who suffered martyrdom in the year 202, he was indebted for a liberal education; and having made great proficiency in the study of the Scriptures and in philosophy, he succeeded, when of proper age, to the office of catechist, under St Clement, in the Christian school of his native city; and in such esteem was he held for piety and talents, that, in his 18th year, he was duly appointed to preside over the catechetical seminaries. Having made a voyage to Rome in the year 213, he, on his return, increased his reputation exceedingly by the publication of various works. He next visited Antioch, and some years after went to Achaia and Palestine, where he was ordained, at the age of 42 years; but having incurred the displeasure of Demetrius, bishop of Alexandria, he was, through the ungracious malevolence of that prelate, excommunicated, and even deposed from the office of presbyter, by a council of Egyptian bishops. Subsequent to this reverse of fortune, he retired to Cæsarea in Palestine, where he rose to considerable eminence as a teacher. This great and good man was treated with unusual harshness and cruelty during the persecution in the reign of Decius; but he submitted with admirable patience to his torments, and survived to console and encourage others under similar trials. He died at Tyre, aged 69, in the year 254. Many excellent works were written by Origen, of which the best edition is that of Father Delarue, a Benedictine, in Greek and Latin, and some fragments of his Hexapla were likewise published, in two volumes folio, by the celebrated Montfaucon. In this work, the loss of which has been regretted by the learned, there were six columns, and hence it derived its name. The first column gave the Hebrew text of the Bible, the second gave the same in Greek characters, the third the Greek version of the Septuagint, the fourth that of Aquila, the fifth that of Symmachus, and the sixth the Greek version of Theodosian. The idea of the Polyglot Bibles was derived from the Hexapla.

ORIGEN, a Platonic philosopher, cotemporary with the foregoing, was a disciple of Porphyry, and has been often injudiciously confounded with the great Origen.

ORIGENIANS, an ancient heretical sect, remarkable only for their errors and abominations, in which they even surpassed the Gnostics, and who, according to Epiphanius, existed about the time of the Christian Origen, and were distinct from the Origenists or followers of Origen Adamantius. It is, however, supposed by Baronius, that there was but one Origen at the time, and that this sect was named after him, an opinion in which Dr Lardner concurs. But indeed the latter seems to think, that the accounts of the impure Origenians are entirely fictitious, and must have proceeded from the invidious enemies of Origen.

ORIGENISTS, a Christian sect of the 4th century, who were so called from Origen, whose tenets they professed to embrace. They entertained some very absurd notions, and believed, in particular, that the souls of men had a pre-existent state; that they were holy intelligences, and had sinned in heaven before the creation of the body; that Christ is only the son of God by adoption; that he has been successively united with all the angelical natures; that in future ages he will be sacrificed for the redemption of the devils, and that the punishment both of them and the damned will be limited to a particular period.

ORILLON, in fortification, an inconsiderable rounding of earth, faced with a wall, and situated on the shoulder of a bastion, which has casements to shelter the cannon on the retired flank, and prevent the enemy from dismounting them.

ORION, one of the constellations of the southern hemisphere, for an account of which see ASTRONOMY. The epithet of *Aquosus* was given to this planet by Virgil, from the supposition of its being accompanied, at its rising and setting, with great rains and storms, which circumstance rendered it peculiarly terrific to the ancient mariners.

ORION, in mythology, is fabled to be the son of Hyrieus, a native of Tanagrus in Bœotia, by the water of Jupiter, Neptune, and Mercury. Owing to his attachment to astronomy, he was after death changed by Jupiter into a constellation.

ORISSA, a considerable province of the Deccan, extending from the 16th to the 23d degree of north latitude. See HINDOSTAN.

ORKNEY and ZETLAND,—a stewarty or county in Scotland, being the most northerly of the British isles. It consists of two clusters of islands. Orkney extends betwixt 58° 47′ and 59° 20° north latitude, and betwixt 2° 4′ and 3° 23′ west longitude; Kirkwall, the chief town, being in 58° 59′ 31″ north latitude, and 3° 23′ 6″ west longitude of Greenwich. Zetland, the more northerly group, lies betwixt 59° 56′ and 61° 11′ of north latitude, and between 52′ and 1° 57′ west longitude. The extreme length of the whole stewartry from Brimsness, washed by the Pentland frith on the south-west, to the Scaw at the most distant point in Zetland, is above 200 miles. But, independently of smaller friths and arms of the sea which intersect the two main districts, there is an extent of sea betwixt North Ronaldsay in Orkney and Sumburgh head in Zetland of about 50 miles, Fair isle being nearly equi-distant from both clusters.

This stewartry is divided into three districts; the earldom of Orkney, the bishopric of Orkney, and the lordship of Zetland. The total population, by the census of 1821, was 53,124, (having increased 7971 during the preceding ten years,) of which the earldom contains 18,179, the bishopric about 9000,—being in Orkney a total of 27,179,—and the lordship of Zetland 25,945. These are scattered over 23 inhabited islands in Orkney, and 30 in Zetland. There are also some small uninhabited islands, the whole number in both clusters being 176. The stewartry is separated from Caithness on the mainland of Scotland by the Pentland frith, which is about 12 miles in width betwixt the opposite headlands. It is washed on the east by the German ocean, and on the north and west by the great North sea and Atlantic.

There are 31 ecclesiastical benefices in Orkney and Zetland; of these 19 are situated in Orkney, and 12 in Zetland. There are three presbyteries in Orkney, forming one synod; and in Zetland there is one presbytery. The land-tax of the whole stewartry is L.729 Sterling per annum, of which Orkney pays two-thirds, and Zetland one-third. The valued rent of Orkney is stated at L.56,551, 9s. $1\frac{2}{5}$d. Scots, and the corresponding proportion for Zetland will thus make the total valuation L.84,832, 3s. $7\frac{2}{3}$d. for the stewartry. The real rents cannot be stated with any degree of accuracy.

The features of the surface of the country in Orkney and Zetland differ considerably in character. With the exception of Hoy, Rousay, and Westray, the Orkney islands are in general flat and more fertile than those of Zetland, which are mountainous and barren, yet picturesque in rock and hill scenery.

*Pomona, or Mainland,* is the largest of the Orkney islands, being in length, from Birza to Roseness in Holm, about 20 miles, and 12 or 14 in breadth from Howton to Costa. Its population in 1821 was 15,062. It is divided into two portions by the parish of St Olla, where the opposite bays of Scapa and Kirkwall form an isthmus of about a mile in width. The west Mainland is more hilly than the east,—a range beginning with Wideford hill near Kirkwall, and extending westward through the parishes of Firth, Orphir, Rendal, and Evie, to Costa head. Another range of high lands extends from Stromness northwards; but, except the hills of Wideford and the Ward hill of Orphir, none of these are of any considerable height. The harbours in this island are Deersound, Inganess bay, Kirkwall, Stromness, and Holmsound; and roads have been begun and are in progress, for intersecting the whole island in the most convenient directions, as marked on the map constructed by Mr Matthieson, land-surveyor, for Mr Thomson's atlas of Scotland. *South Ronaldsay* and *Walls,* (including Hoy,) are the two most considerable among the South isles. The former contains a population of 1949, the latter of 1217; the former embraces the harbours of St Margaret's Hope and Widewall; the latter, Langhope, Orehope, and Kirkhope. The Wardhill of Hoy is 1564 feet above the level of the sea, being the highest land in Orkney. Of the North isles, those of, 1. Shapinshay, 2. Rousay, 3. Westray, 4. Eday, 5. Sanday, and 6. Stronsay,—are the most considerable; the 1st contains 780 inhabitants; the 2d 834; the 3d 1947; the 4th 6731; the 5th 1860; and the 6th 1013. For a particular account of the Zetland islands, see ZETLAND, under which head will be found an account of the natural history and fisheries, manufactures, and commerce of Orkney and Zetland.

*The chief towns and villages* of this stewartry are, Kirkwall, Stromness, and St Margaret's Hope in Orkney, and Scalloway and Lerwick in Zetland. The first mentioned has already been noticed, (see KIRKWALL,) and, except its remains of antiquity, it possesses but little to require further observation. Its population in 1821, within the burgh, was 2212, and its suburbs and landward district contained 1034, making a total of 3246 souls. There is a respectable library in it, which was originally instituted in the time of episcopacy, but was revived and extended in 1814, chiefly by the liberality of the late Mr Malcolm Laing, Mr Balfour the present member of parliament, (who, some years ago, mortified L.500 for the benefit of the school of Kirkwall,) and some other individuals.

*Stromness* is situated on the margin of a fine basin, ormerly called the bay of Kerston in the west Mainland of Orkney. It has gradually arisen from the frequent resort of shipping to this harbour. During the episcopate of Bishop Grahame, that prelate granted feus to five or six persons about the year 1727, of some small patches called quoys, on the west side of the bay; and on these small enclosures, subdivided and extended by encroachments on the adjoining common, the village has since grown up. By the last census in 1821, it contained 2236 inhabitants, occupying nearly 400 houses, and the parish, beyond the limits of the burgh, contained 708 persons. In 1817, the inhabitants of this town were incorporated by a royal charter, and it was erected into a free burgh of barony, with powers of choosing magistrates and a council for the government of the town and harbour. In 1824 they obtained a decree of the Supreme Court in Scotland, declaring Stromness to be a separate and distinct parish, which will in future secure to its population the benefit of a clergyman's undivided attention, and of a parish school,—advantages which had heretofore been denied to it by an unwarranted junction of it to another parish. A library also has been established; and a regular communication by packets, once or twice in the month, opened with Leith and Edinburgh. Nothing is wanting but the circulation of capital, the improvement of the adjacent districts, and a moderate portion of public spirit, to render Stromness the most thriving town in Orkney. The only public building is a modern church.

*St Margaret's Hope,* a thriving village in South Ronaldsay, is built on the beach of a small harbour from which it takes its name, where the herring-fishery has of late years been carried on with great spirit. During the fishing season there may be 300 or 400 persons resident in St Margaret's Hope and its vicinity. Next to Stromness, this is the most rising village in Orkney.

*Scalloway,* although now the smaller is the more ancient of the two towns in Zetland. Anterior to the connexion of these islands with Scotland, it was the chief seat of justice, from whence the parish in which it is situate derives its name, *Tingwall.* Scalloway-banks continued long to be the place where courts of justice were held; and the extant records from 1602 downwards are evidence of the fact. It was the place where all proclamations were published, and in some old charters it is spoken of as a burgh; probably a baronial one, in the time of the earls. It is now a scattered village of humble looking dwellings. The present population is about 300; and its fine harbour, in the vicinity of extensive fishing banks, has been the cause of a considerable revival of its former relative importance. There are about 20 vessels constantly engaged from Scalloway in the deep sea fishing; and for a great part of this spirited exertion, as well as for agricultural improvements, the community of Zetland are deeply indebted to the worthy clergyman of the parish, Mr Turnbull.

*Lerwick,* now a burgh of barony, is situate on the east side of the mainland of Zetland. Like Stromness, it owes its existence to the fine harbour Brassay sound, on whose bank it is built. It originally consisted of a set of huts, reared temporarily for the convenience of the natives, who flocked thither to traffic with the Dutch fishers when their fleets moored in the harbour; and it had become such a nuisance from this cause, that, about the year 1620, there was a solemn act of the local authorities for demolishing it on account of the "sins and iniquities" which abounded in it. It was, however, rebuilt, and in 1700 it contained betwixt 200 and 300 families; and in the course of 30 years previous to that date, the number of houses increased from four huts to 200. It now contains about 2000 inhabitants, and is superior to Kirkwall or Stromness in appearance and cleanliness, the houses and shops being generally more commodious, and in better taste. In 1818, it was erected, like Stromness, into a corporate town, with magistrates and a council. It has a court-house in which the sheriff, admiral, and justice-courts are held; a parish church, recently erected, and Fort Charlotte, (originally built by Oliver Cromwell's troops, and afterwards restored in 1665 and 1781) are the only other public buildings in Lerwick.

The *Antiquities* of Orkney and Zetland are perhaps among the most interesting objects which those islands present to the observer's attention. Of these, however, we can only give a very short sketch. The more ancient are the circles of stones, obelisks, and Picts' houses, as they are termed in the district. There are numberless barrows or tumuli scattered over all the islands. Some of these contain urns or rude stone coffins, which inclose ashes mixed with fragments of bones, and others skeletons of human beings. The stones of Stenness are two very remarkable circles of rude pillars, which stand nearly in the centre of the Mainland of Orkney, on two peninsulas, separated from each other by a narrow channel of the Loch of Stennes. In one of these the pillars are eighteen feet high above ground, in the other smaller; and as many of them have fallen, while others have been intentionally demolished, and no means are taken for preserving them, these curious relics of superstition, in a remote age, are likely soon to be entirely lost. There are single large obelisks in Shapinshay, Eday, Westray, South Ronaldsay, and in different parts of the Mainland, which evidently belong to the same æra. The Picts' houses, too, are the remains of ancient times, of which we have no clear record. They generally stand on the high promontories at the sea-beach, all along the coast, in sight of each other, near a landing place, and in the vicinity of a townland or space of arable ground. They are circular in their form, of solid masonry and various dimensions, and, in ruins as they are, they appear to have had some smaller outworks, now crumbled at their bases. There can be but little doubt that they were watch-towers and places of strength and refuge, to which the inhabitants of the neighbouring hovels retired on the alarm of danger. The most perfect of these which we have seen are in Evie and Stronsay in Orkney; but the most entire of them all is the one in Mousa, which is said to have been occupied by Earl Erland in 1154, and which still appears conspicuously, from the sea, in coasting along the shores of Zetland.

Of the later antiquities, the cathedral church of St Magnus at Kirkwall is the most conspicuous. Its length is 226 feet, its breadth 56. The transept extends 28 feet beyond the side walls; the height of the roof from the floor is 71 feet, and the spire on the top of the central tower 140 feet. The tower is supported on four Gothic columns 24 feet in circumference, from which arches spring to support the superstructure. In the quire there are on each side six arches, and in the nave eight arches, of the Gothic order, supported on columns, making in the whole length of the cathedral 15 arches on each side. The eastern window is somewhat handsome; and the building, though gloomy, and perhaps heavy, arising from the red sand stone of which it is built and the smallness of the windows, is yet one of the finest structures in Scotland. It was founded by Ronald, count of Orkney, prior to 1159. A considerable addition was made to the quire in the episcopate of Edward Stewart; and Bishop Reid, the last Roman catholic prelate, completed it as it now stands. The quire is still used as a place of worship, for which, in its present state, it is very unfit; and although a good deal has been done to uphold the fabric, it cannot long withstand the ravages of time in a tempestuous climate, unless some spirited effort be made to preserve it.

Next, perhaps, in point of antiquity to the cathedral, is the bishop's palace, in the vicinity of which only a small portion of ruins now remains. The date of its erection is uncertain, and it is remarkable chiefly for being the house in which Haco, king of Norway died, and in which King James V. lodged when he visited Orkney. The castle of Kirkwall was built by one of the St Clairs, earls of Orkney, about the year 1400. It was demolished in 1614, and what remains of it is left in a deplorable state of neglect.

Noltland castle, in Westray, is another building of which the history is doubtful; and although the popular tradition, (that it was built by M. Balfour for Bothwell when he married Queen Mary,) may to a certain extent be true, yet there is evidence that, prior to that time, it existed as a place of strength in an unfinished state. "The house of Westray" is frequently mentioned in the privy-council record in the time of Queen Mary. It is a noble building, and capable of being long preserved as a memorial of power departed.

The palace of Birza, in the west Mainland, was built by Earl Robert Stewart. It is well situated for so remote a residence, on the verge of the most fertile tract of land in Orkney. It has been sadly dilapidated, however, and no means seem to be taken for preserving its fragments from the plunderings of the neighbouring peasantry. This is equally true with regard to Scalloway castle and the Earl's palace at Kirkwall, both built by Earl Patrick Stewart, about the year 1600. They are fine specimens of the castellated buildings of that age; but have long been roofless receptacles of filth, and treated by the rabble with a heartless feeling of mockery, which is calculated to sweep from the face of our country all such monuments of Scotland s ancient history.

Of the *Agriculture* our notice must be very brief; and on this part of our subject we refer to Mr Shireff's excellent agricultural report, which is minute and faithful. We may only remark, that it is still very far behind, although great improvements have taken place within the last twenty years. The lands generally lie in *runridge*, or much intermixed; there are few leases calculated for the encouragement of agriculture: the dwellings of the farming population are mean and comfortless; a rotation of crops is very little heeded; and the strongest prejudices exist against any change in the rural customs of the peasantry. There is little draining, little inclosure or subdivision of fields, and little encouragement given by the landholders. Still, however, something has been done. In Zetland, an agricultural society has been instituted; and the premiums given by the Highland Society of Scotland, both in Orkney and Zetland, for green crops, have, within a few years, given a strong impulse, and had the effect of inducing a good many small farmers to attempt this most important addition to their rural treasures. The old and rude implements of husbandry are gradually disappearing, although in some parishes and islands there are no other to be seen; and wherever roads have been made, carts are fast superseding the creels and *casies* on horses backs, which were very lately the only methods of transporting farm produce from one place to another.

*History, Laws, &c.*—The earliest notice of Orkney in the writings of ancient authors which has yet been found, is to be seen in *Pomponius Mela*, lib. 3. ch. 6. The date assigned to his mention of the *Orcades*, (by which name they were subsequently distinguished among the Roman writers,) is the 45th year of the Christian era. Pliny, about 30 years after, states the number to be 40; and, with the exception of Solinus, (A. D. 240,) who makes the number only three, most of the ancient writers speak of it as betwixt 30 and 40, referring, perhaps, to the number inhabited. We have the authority of Tacitus, that they were visited and subdued by the Romans under Agricola.

As to Zetland,—its discovery, transactions, and destinies are so completely connected with Orkney, that a history of the one division is almost a transcript of the other's chronicles. They form, in fact, but one province; and any peculiarities by which the one set of islands is distinguished from the other, are too trivial to require separate enumeration.

Torfæus and other writers begin something like the history of these islands with the invasions, first of Zetland and afterwards of Orkney, by a set of Norwegian marauders under Harold Harfager, their king, who, extending his conquest further among the British islands, delegated the rule over Orkney and Zetland to Ronald, count of Mercia. He, in his turn, transferred it to his brother Sigurd, who was created the first earl of Orkney about the year 920. From that time till the islands were transferred by Norway to Scotland in the year 1468, the history of the district is merely a narrative of the squabbles, murders, and mutual depredations of a horde of barbarians and pirates, blended with extravagant fables, many of which are altogether unworthy of notice. Our attention is, therefore, more peculiarly called to what may be deemed the authentic annals of these islands on their annexation to Scotland.

After the battle of Largs, Magnus IV. of Norway and Alexander III. of Scotland entered into a treaty in the year 1266. By it, the isle of Man, and other western islands which had been conquered by the Scandinavian pirates, were ceded to the Scottish king; but Orkney and Zetland were reserved to Norway, and Alexander became bound to pay 1000 marks annually to the Norwegian monarch—whence this tribute got the name of *the annual* of Norway. This tribute never was paid, and perhaps never was meant to be paid. But, on the marriage of James III. of Scotland to a princess of Denmark and Norway, the arrears of "the annual" were discharged, and Orkney and Zetland were pledged as a surety for 60,000 florins, as the dowry of the royal bride. This affair was arranged by a treaty in September 1468. The St Clairs, earls of Orkney, had an extensive estate and dominion in those islands; and being also subjects of Scotland, where they had considerable estates, the king gave the castle of Ravenscraig, with lands in Fife, for the earl's right to the earldom, (1471,) thus uniting the character of proprietor and sovereign. Of the queen's marriage-portion only 2000 florins were paid, Orkney being mortgaged for 50,000, and Zetland for the balance of 8000. The pledge was never redeemed, and these islands have formed a part of the kingdom of Scotland for above 350 years.

At the time of the annexation, and long anterior to that event, the Christian church had an extensive estate in lands and tithes, scattered over, or leviable from the whole of the islands. The inhabitants, too, consisted chiefly of numerous small land-owners, who held their properties according to the odel or udal laws of Norway; and these udallers paid to the sovereign, or to the earls, and the church, certain *scats* or tributes, as a land-tax on their possessions. The transfer of the islands to the crown of Scotland was therefore a transfer of sovereignty; and when to this the earldom estate was added, it was still clogged with the rights of the church and of the udallers.

In these circumstances, an act of the Scottish parliament was passed, on the 20th of May 1471, annexing the earldom of Orkney and lordship of Zetland to the crown, to be given away in time coming to "na persoune nor persounes, except only till ane of the kingis soneis of lachful bed." For a time the crown revenues were farmed out; and, in 1474, the bishop of Orkney had a lease of them. In 1478, Andrew, another bishop of Orkney, got a lease, including the castle of Kirkwall; and, in 1489, Henry Lord Sinclair, a son of the ancient earls, obtained a lease for the same rent. In 1501 it was renewed for 19 years; and the jurisdictions of justiciary, foudrie, (a Norwegian authority,) and bailiary were annexed. The Sinclairs continued to possess the earldom in this way for a considerable time. But, in 1530, king James V. granted a *feu* of the islands to his natural brother the first Earl of Murray, of the name of Stewart; it was soon recalled; and, in 1540, the lands and lordship of Orkney and Zetland were, by another act of parliament, annexed to the crown, to remain perpetually, and not to be alienated therefrom without an act of parliament previously passed, and for the "weilfare of the realme." The queen-dowager of king James V. enjoyed the castle and earldom as a part of her jointure.

Notwithstanding the two acts of annexation, declaring any grants, without the previous sanction of parliament, to be null, Lord Robert Stewart, a natural son of king James V., obtained a gift without any such preliminary. This grant was afterwards superseded by one to James Earl of Bothwell, created duke of Orkney on his marriage with Queen Mary in 1567. After his fall, Lord Robert again got another grant in 1581, and was created earl of Orkney. The grant was again recalled in 1587, and again renewed in 1589. This last gift to Lord Robert and his son Patrick, in fee, was ratified by parliament in 1592; and, in 1600, Patrick got a new grant, under which he possessed till the year 1612, when an act of parliament was passed annexing the earldom once more to the crown, and erecting it, as a royal estate, into a stewartry, comprehending both Orkney and Zetland. The earl was soon afterwards executed for alleged treason. On this seventh resumption by the crown, an act of the king and council was published at the market-cross of Kirkwall, and other places in Orkney and Zetland, "that the lands and earldom of Orkney and Zetland are annexed to the crown, to remain perpetually and inseparably therewith in time coming."

The bishopric lands and tithes were intermixed in *runridge* all over Orkney and Zetland with those of the earl; and as continual outrages were created by the jarring interests of the earls and bishops and their respective tenants, as well as among the smaller proprietors, a plan was devised in the act 1612 for disjoining the intermixed properties and rights of the earldom and bishopric. Commissioners were appointed for adjusting the interests of parties; an *excambion* or mutual exchange was effected, and, in 1614, ratified and completed, by a new crown charter, to Law, who was then bishop of Orkney and Zetland. The episcopal palace and the nearest lands in the parish of St Olla, adjacent to Kirkwall, with lands and the whole teinds and scats of the parishes of Holm, Shapinshay, Stromness, Sandwick, Hoy, Walls, Orphir, and other detached islands. were erected of new into a bishopric, over which the prelates were to hold the temporal jurisdiction of sheriffs, superiors, and landlords, independently of their spiritual authority over all Orkney and Zetland, and the patronage of all the ecclesiastical benefices, for the actual service of religion. From the time of that *excambion* in 1614, the bishopric has been a distinct and separate territory, clearly defined; and the rest of the stewartry consisted of the earldom of Orkney and lordship of Zetland.

The earldom was again, after 1614, farmed out successively to Sir James Stewart of Kilsyth, afterwards Lord Ochiltree, to Sir George Hay of Kinfauns, (for a rent of 40,000 merks Scots,) to the first Lord Napier of Merchiston for a rent of 45,000 merks, he drawing 7000 merks more from a subtenant, and on short leases of two years at a time to persons of inferior note. Such was the rigour of the exactions by those middlemen and their stewards, and so loud the outcry of oppression, that, on the petition of the inhabitants, "that no man be interponed between his Majesty and them, but that they may remain his own immediate vassals," an act of parliament was passed, in 1633, ratifying all the former annexations.

In 1643, the earl of Morton obtained from king Charles I., in the form of a mortgage, for a debt of L.30,000, a grant of the earldom, to be held by him and his heirs until the same should be redeemed. The mortgage was ratified by parliament in 1644. His lordship having retired thither during the troubles in the first Charles's reign, the family continued to possess under it till, in 1651, they were driven from it by Cromwell's soldiers, in consequence of their participation in the last gallant attempt of Montrose (1649-50) to restore his royal master. But at the restoration of King Charles II. they resumed possession of the earldom, in June 1661. The mortgage, however, was annulled by the general revocation of Charles II. A renewal was obtained soon afterwards in favour of Viscount Grandison for behoof of the Earl of Morton. In 1669, the Lord Advocate brought a suit, and obtained a decree of the supreme court, by which this mortgage was once more cancelled and set aside. This was followed by an act of parliament the same year, in which the earldom of Orkney and lordship of Zetland were again declared to be a stewartry, and once more annexed, "to remain inseparably with the crown in all time coming."

The earldom remained annexed to the crown for about sixty years, when, at the time of the union of England and Scotland, it was a third time mortgaged to the Morton family, on the former ground of the L.30,000 debt; and, in 1707, an act of dissolution was obtained from parliament, and a new grant followed in favour of his lordship, but still in the form of a mortgage, and redeemable for the old sum of L.30,000, burdened with the payment of L.500 per annum in name of feu-farm. A charter followed on this act, and it was ratified by another act of parliament the same year.

Matters continued in this state till the year 1742, when Lord Morton petitioned parliament for an act to render the mortgage an irredeemable grant; the earldom was dissolved from the crown for ever, and vested irredeemably in the earl. The Earl of Morton received a compensation of L.7147 Sterling for his heritable jurisdictions when abolished in 1747; he afterwards, in 1766, sold his rights in Orkney and Zetland to Sir Laurence Dundas for L.60,000, and the earldom is now vested in Sir Laurence's grandson, the present Lord Dundas. The late Lord sold to the landholders in Orkney and Zetland feu-duties to the amount, it is said, of about L.50,000.

After the arrangement of 1614, the bishopric estate was enjoyed by the prelates till the abolition of episcopacy in 1638-9, soon after which it was given to the magistrates of Edinburgh, who, at the restoration in 1661, got compensation for it, and it was again given to the bishops, who enjoyed it till the revolution in 1688. It was then worth L.600 Sterling, per annum, exclusive of burdens, and was soon after let for the annual rent of L.400 Sterling. Since that time it has generally been leased to persons having interest to obtain grants. During the time that the Morton family held the earldom, the bishopric was frequently farmed from the crown by their chamberlains, who communicated a part of the benefit to their lordships; and, after the sale of the earldom, Sir Laurence Dundas obtained, in the year 1775, a lease of the rents and revenues of the bishopric during his Majesty's pleasure. His son, in 1781, obtained a lease for nineteen years of some crown lands, and since that time he and his successors have enjoyed the whole for a nominal rent of L.50 Sterling per annum. In consequence, however, of recent official inquiries, the Lords of his Majesty's Treasury have lately (1824) put this part of the king's estate, in these northern isles, under the management of the Barons of Exchequer for Scotland. The bishopric lands and revenues are computed to be worth nearly L.2000 per annum.

The *laws, usages,* and *political state,* are, among the British provinces, peculiar to these islands, being of Norwegian origin. In the year 1423, as appears from Torfæus (*Hist. Orcad.* p. 179,) a complaint was exhibited against the governor of the islands to the King of Norway for imprisoning the *lawman,* and extorting from him the *Codex Legum,* or Book of the Law. This record of its canons survived the transfer of the islands; for, in a complaint against Lord Robert Stewart, (9th Feb. 1575) it seems, by the records of privy-council, that the "Book of the said Law" was ordered to be produced; and, in deciding a cause, 23d Aug. 1602, the Court, in reference to it, were governed in their verdict "be the inspection of the chapturis of the *law buik,* and practices of the countrie in sic caices."

While under the dominion of Norway, Henry St Clair, Lord of Roslin, (descended of Magnus,) obtained from Haquin, king of Norway, on the 2d of August 1379, a written investiture as Earl of Orkney, by which he was bound to protect and maintain the inhabitants in all their rights, and was declared subject to the laws of Norway. In 1434, his grandson, Earl William, obtained a similar investiture on the same conditions; and when the islands were mortgaged to Scotland in 1468, the Norwegian laws and usages regulated all the rights of property in the district. The historians and institutional writers of both countries, Torfæus, Buchanan, Craig, and others, all mention that these laws continued after the transfer; and indeed these authorities are fully corroborated by our own parliamentary records, and a series of authentic documents. In 1567, there was an act of parliament declaring that Orkney and Zetland should be subject to their own laws, and not to the common law of Scotland. Accordingly, in the grants and leases by the kings of Scotland, from the time of the mortgage down to the year 1600, the grantees were expressly bound to administer justice "according to the laws and usages of the countrie of Orkney and Zetland." In 1690, another act of parliament was passed confirming the land-rights held according to the ancient law of the islands; and no act of the legislature having since abrogated that law, it subsists to this day, and is fully recognised in the courts of Scotland.

The laws of Orkney and Zetland consisted in a system of judicatories and police; in the rules of succession to property; in the tenure under which land is occupied by the owners; in the burdens by which it is affected; the weights and measures, and what may be termed the common-law usages of the province, as indicated by the records of its courts; all differing essentially from those of Scotland, and bearing some affinity to those of the isle of Man, which have marks of the same origin.

*The judicatories* were courts composed of a judge called a *foud,* or lawman, who was assisted in his deliberations and decisions both legislatively and judicially by a court or assize. There was a supreme *foud,* as well as inferior local fouds, in every island or parish; and the courts were called *lawtings.* The number of councillors or jurymen required to act along with the foud, does not seem to have been uniform; sometimes twelve, and at other times above twenty, being present in the supreme lawting. They were termed, as in Norway, *lag-ret-men,* that is *law right-men*; and appear to have possessed not merely a power of enacting laws, but of judging in all causes civil and criminal, and of inflicting capital punishments: and the supreme foud and lawting had an appellate jurisdiction from the inferior courts. This general lawting asserted its exclusive and privative authority, and frequently prohibited the inhabitants of the islands from resorting to the Scottish courts, even so late as 1602. There is a charter of the year 1498, in which David Sinclair is designated Fold of Zetland: The jurisdiction of foudrie was continued in all the grants of authority to the justiciars and sheriffs for this district under the Scottish crown; and there are now several records extant in the register-house, Edinburgh, and sheriff's office at Kirkwall, extending from 1602 to 1670, in which both the proceedings, judicial and legislative, are inserted, blended indeed with a mixture of Scottish law terms, but still preserving the original titles of fouds, law-right-men, lawtings, &c.: and besides the stewartry acts, made at different times, particularly in 1615, and which are still in partial observance as consuetudinary rules of police in both districts of the stewartry, the parish bailies or fouds continued to act along with their subordinates till the abolition of the heritable jurisdictions in 1748, since which time all traces of them have gradually disappeared and merged in the forms of the Scottish judicatories.

*The rules of succession* in property, and the *tenure* by which it is held, are essentially different from those of Scotland; and in the latter particular are still in full operation. That tenure is the *udal,* (in modern Danish, odel,) derived from the Danish and Swedish *oede* signifying *waste, uncultivated;* and *udaler* means the first cultivator of *waste* and till then unappropriated land, or his descendants. The Danish and Swedish *œ* dipthong is sounded pretty much like the French *u,* and that sound is still preserved in the language of the Orcadians: they in writing have turned the old *odal* into *udal.* This tenure is very simple in its nature. Possession is its essential quality, independently of written title, or the acknowledgement of any superior, which are the characteristics of the feudal holding. Besides many passages in the books of the lawtings, the following distinct testimony as to the succession in this species of heritage is given by a chief magistrate of Orkney and Zetland, and other persons of consideration, in an authentic document, which is now deposited at the register-house, Edinburgh; it is dated 20th July 1610. That instrument states, " that in all times bygane, past memorie of man, there has been ane antient law, custome, and consuetude within the country of Zetland, be the quhilk it has bene inviolablie observit, that when ony landit man havean landis within the said country, depairtit this mortal lyffe, the haill lands and heretage appertening to him in his lyftime, immediately efter his deceis war equallie and lauchfullie devydit amangis his haill bairnis, alsweill sons as dochteris, comptand always twa sistaris partis for ane brotheris pairt; and being sua divydit, the eldest brother had no farder prerogative above the rest of his brether, except the first choice of the pairtis and parcellis of the landis divydit." Many persons both in Orkney and Zetland still occupy lands under the udal tenure, having no written charter or infeftment from a superior, in the succession of many generations. The Earls of Orkney and Morton induced numbers to take charters from them, and to incur all the casualties of feudal investiture; and it is very doubtful whether the rules of udal succession be now attended to, although they be preserved expressly, and confirmed by the act 1690 of the Scottish Parliament. An udaller is not entitled to defeat the udal rules of succession by preferring any of his children, or to sell his udal lands, but in very peculiar circumstances, after first offering them to the udal born, *i. e.* to his kindred; and it is curious to remark the coincidence which there is betwixt the rules stated in the records of Orkney and Zetland and the Norwegian laws on this subject. We have, under NORWAY, given a translation from the laws of Norway, "*Kong Christian den Femtes Norske Lov*," published by authority at Copenhagen in 1800. Bishop Pontoppidan, in his work on Norway, published in 1751, gives an account precisely similar of the *odal* tenure and its distinctive qualities.

The udallers paid a *scat* or tribute to the king of Norway before the mortgage to Scotland, and it is still exacted. In all the Scandinavian dialects, *scat*, *skat*, or *skot*, means a tribute or taxation; and we have the authority of Torfæus, (Lib. 11. p. 189,) that when Christian, king of Norway, pledged the islands to James III. of Scotland, he wrote to the inhabitants desiring them to acknowledge the Scottish king as their sovereign, and to pay their *scat* to him. That it was a land-tax payable to the sovereign, and not an arbitrary symbol of feudal vassalage, is manifest from the fact that it was distributed among the udalmen, and levied from them in proportion to the extent of their udal lands; and, in as far as not redeemed, they still constitute a burden on every landholder within the stewartry.

For the first 150 years after the annexation to Scotland, the inhabitants had no representative in its legislatures. The earl and bishop, indeed, were peers of parliament; but their own interests were the only matters to which they paid attention. The lawtings were a sort of local legislature, but they were overawed by the ascendancy of their lords, and ceased to watch over the general welfare. In 1617, however, a commissioner was summoned for the first time. For sixty years afterwards there was no representative of these islands in the Scottish parliament. At the restoration they were again admitted within the pale of the constitution; and in the years 1660, 1661, 1662, 1663, 1667, 1669, 1678, 1681, 1685, 1689, and 1702, the gentlemen, feuars, udallers, and land-holders of Orkney and Zetland, concurred in electing representatives; and an act of parliament was passed, (1669,) confirming their right to do so in future. This privilege was usurped chiefly by a few of the Orkney proprietors; and the Zetlanders, from the remoteness of their situation, their poverty, and other circumstances, were entirely disregarded and borne down. A new qualification having been introduced by the act 1681, which required 400l. valuation to constitute a freeholder, and the proprietors of Zetland never having obtained a valuation, they were entirely excluded by Orkney. But in consequence, however, of application for relief from the heavy exactions made on them, the privy-council issued a commission for the valuation of that district in 1688,—but the commissioners neglected it; and having again applied, in 1691, through the medium of their chief magistrate, for a renewal of that commission, it never was obtained. An action at law has recently been instituted, for the purpose of admitting the Zetland landholders to the elective franchise.

ORLEANOIS, an old province of France, which included the districts of Orleanois Proper, Beauce Proper, or Chartrain, Dunois, Vendomois, Blaisois, the greater part of Gatinois, and Perche-Gouet, and whereof Orleans was the capital; together with Blaisois and Chartrain. It is now divided into the three departments of Loire and Cher, the Loiret, and the Eure and Loire.

ORLEANS, the capital of the department of Loiret in France, pleasantly situated on the river Loire, over which there is a fine bridge with nine arches, is chiefly built in the ancient style, and with straight but narrow streets, the handsomest of which is the Rue Royale, extending from the central square to the bridge. This city contains a splendid cathedral, 22 parish churches and convents, a town-house, theatre, and other public edifices, together with a public library, consisting of 30,000 volumes, and a high school. Being a place of considerable magnitude, it was at a former period a bishop's see, and had also an university and several courts of justice. The inhabitants, amounting to upwards of 36,000, are chiefly employed in the manufacture of woollen stuffs, hose, hats, and leather, and in sugar-refining; and some trade is carried on in corn, wine, fruits, and brandy. There is in the principal street of Orleans a monument commemorative of the victories obtained over the English by Charles VII. and which was erected by that monarch in 1458; and a picture, the best now extant, of Joan of Arc, the Maid of Orleans, is preserved in the Hotel de Ville. To the north of this city there is an extensive forest, and the surrounding country has a very beautiful and interesting appearance.

ORLEANS, the central county of the three northern ones in the state of Vermont in North America, is bounded on the south-east by Caledonia county, on the south by Washington county, on the west by Franklin county, on the east by Essex county, and on the north by Canada, and contains 23 towns, the principal of which are Craftsbury, Irasburg, and Brownington. The inhabitants amounted, in 1810, to 5830.

ORLEANS, a county in the state of Louisiana, which consists of the parish of Orleans, the city, suburbs, and precincts of New Orleans, and the parish of Placquemine. It is rather an unhealthy country, but a place of considerable trade in produce of various kinds. Population, in 1810, about 24,500.

ORLEANS, New, the capital of the province of Louisiana in the United States, extends along the east bank of the Mississippi, and is regularly built with wide streets, which intersect each other at right angles. The houses are generally constructed of wood or of brick; and the population, in 1813, amounted to 24,559, including the inhabitants of the suburbs and precincts. Among the public edifices may be noticed the cathedral, the town-house, and the convent of Urseline nuns, instituted, in 1727, for education of female orphans. An earthen embankment, called the Levee, about six feet in height, stretches from Fort Placquemine, 43 miles below this place, to the Ibberville, at the head of the island of Orleans, 121 miles above it, and, passing the front of the town, constitutes an agreeable promenade. From a basin behind the charity hospital of New Orleans, a canal, 20 feet wide, flows to St John's creek, which is navigable, and takes a northern direction to Lake Ponchartrain. From the extensive marshes in the vicinity, New Orleans is rendered unwholesome; but it possesses facilities for commercial intercourses.

ORMSKIRK, a market-town of Lancashire in England, consisting of four principal streets, and containing an ancient church, several chapels, and other public buildings, and a population of more than 3000. It has a considerable inland trade through the rivers Mersey, Dee, Ribble, Ouse, Trent, Derwent, Severn, Humber, Thames, Avon, &c. The manufacture of cotton and thread, both by the hand and by machinery, has been carried on in this place to a great extent.

ORMUZ, an island at the entrance of the Persian gulph in Asia, extending about six miles in length, and four in breadth, and traversed from east to west by a mountainous ridge. At one period, it contained one of the most splendid cities in Asia, which was the grand emporium of Indian trade; but which being now in a state of ruins, contains little else than a fort and a suburb, with a population of about 500. This island is very barren, and its main productions are rock-salt, sulphur, and red earth. The white sand of which the soil consists was formerly imported into Europe, and the black shining sand here found is esteemed in India. Ormuz surrendered in 1622 to the combined force of the English and Persians, after which it fell into decay in consequence of the removal of its trade to Gombroon.

ORNANS, a town of the department of the Doubs in France, is seated on the river Louvre, and contains upwards of 3000 inhabitants, who are chiefly employed in the extensive iron-works, and in the manufacture of paper and leather.

ORNE, a department in the north of France, so called from a river of the same name, is bounded on the north by the department of Calvados and Eure, on the west by that of La Manche, on the south by those of the Mayenne and the Sarthe, and on the east by those of the Eure and Loire. Among its productions are wheat, rye, barley, oats, hemp, and flax; and, besides the extensive iron works established in different parts, manufactures of knives, leather, linen, lace, and other articles are carried on. In 1815, the population was 422,000. The chief towns are Alençon, Domfront, Argentan, and Mortagne.

# ORNITHOLOGY.

Definition.

Ornithology, composed of the Greek ορνις a bird, and λογος a discourse, denotes that part of zoology which treats of *Birds.* They are furnished with two feet, covered with feathers and provided with wings, by means of which they are, with a very few exceptions, enabled to fly in the air. Although they have warm blood, a heart with two auricles and two ventricles, and although they breathe by lungs, they are distinguished from the mammiferous animals by their feet, feathers, wings, horny bill, and oviparous production.

## Chap. I. Of the Structure and Economy of Birds.

Structure, &c.

The *skeleton* of birds is of a lighter texture than that of quadrupeds; the spine is immoveable, but the neck is lengthened and flexible; the breast-bone is very large, with a keel in the middle, and formed for the attachment of very strong muscles; the bones of the wings are somewhat analogous to those of the fore-legs of quadrupeds, and, for the most part, terminate in four toes, three of which are commonly directed forwards and one backwards; but in some species there are only two toes, and in some, again, only three.

*Plumage,* &c.—The *feathers,* with which birds are covered, may be compared to the hair of quadrupeds. Beneath the general covering is a finer and softer substance, called *down.* The external, or common feathers, have received different denominations, according to the different parts of the body on which they are situated. Thus, the largest of the wing-feathers, which are, generally, ten in each wing, and which rise from the first bone, are called the *primaries,* the *first,* or *great quills,* or *remiges primores,* being regarded as the main oars, or guiding instruments; those constituting the middle portion of the wing, and which rise from the second bone, are termed the *secondaries, second quills,* or *re-*

Structure, &c.

*miges secundarii*, and are more numerous than the first; those which take their rise also from the second bone, at the elbow-joint, forming a continuation of the secondaries, are called *tertials;* those which originate in the shoulders, and descend along each side of the back, have been called *scapulars;* the smaller ones, which lie in several rows on the wing-bones, and cover the shoulders, are the *smaller wing coverts, tectrices primae*, or *minores;* the next series, which is disposed immediately over the quill-feathers, and the secondaries, consists of the *larger wing-coverts, tectrices majores*, or *secundarii;* and, at the edge of the shoulder on a small joint, rising at the middle portion of the wing, are three or five rather strong and slightly lengthened feathers, forming the *false* or *spurious wing;* the *alula spuria*, or *alulet* of some ornithologists. The tail, in most birds, consists of twelve feathers, in some of only ten, and, in others, of eighteen, twenty, or twenty-four, forming the *rectrices* of Linné. The *uropygial* feathers, or *tail-coverts*, are distributed on the upper side of the tail at the base, as the *hypochondrial* are on the flanks of the same appendage, and the *vent-feathers*, or *crissum*, from the vent to the tail underneath. The *auriculars* are those feathers which cover the ears. *Capistrum* denotes the short feathers on the forehead, just above the bill; *lorum*, or *lore*, the space between the bill and the eye, usually covered with feathers, but in some instances, as in the black and white grebe, naked; *vibrissæ pectinatæ* are stiff hairs which grow on each side of the mouth, exhibiting the semblance of a double comb, as in the goat-sucker, fly-catcher, &c.

The diversities of form, and still more those of colour, in the plumage of the different species, are truly wonderful, and such as to defy the utmost efforts of painting or description. Among the aquatic and rapacious tribes, in particular, the differences of colour in the same original type are so complicated as to render the determination of the species, and even of the sexes, a task of no easy performance. The most stable tints are, perhaps, those which are first formed on the great quills of the nascent bird; and Linné has remarked, that the first quills and the tail-feathers are least liable to change their hues; but that they do undergo variation in this respect, has been repeatedly ascertained in several species. The circumstances of age, sex, moulting, season of the year, and climate, contribute to produce very considerable alterations in the shadings and markings of the feathered race; the swan, for example, which is afterwards so white, is of a black hue when young; the plumage of female birds is generally more dull and sober in its tints than that of the males; while that of birds indigenous to warm and tropical regions, is, for the most part, more vivid and gaudy than that of those which frequent the more temperate and the colder latitudes. The colours of birds are, moreover, affected by habits of domestication, and they glow with the greatest lustre during the season of love. In this, as in most other classes of animals, individuals are occasionally met with of a sickly white, connected with redness in the eyes, the effect, it is presumed, of some organic debility. *Moulting*, which seems to be analogous to the defoliation of

Structure, &c.

the larger vegetables, produces a marked change in the outward covering of living beings. Birds are subjected to its influence chiefly in autumn, when they appear not only divested of their gay attire, but when they court solitude, lose the sweetness of their notes, and are deprived of their wonted vivacity. Such of them as moult twice in the year, also change their feathers in spring. Most of the young males, which originally bear the plumage of the female parent, assume, at their first moulting, the hues which they subsequently retain; but some species do not put on their characteristic garb till the end of the second, of even of the third year. Among those which moult twice a year, both males and females change their plumage; but the latter retain the same markings, while the former exhibit a more specious covering in the season which precedes their pairing, and a more homely one, often similar to that of the female, after the period of breeding. In most cases the feathers fall off in gradual succession, but in some species nearly the whole plumage comes off simultaneously, and is speedily replaced. During the continuance of this process, birds appear to be sickly and disordered, the bolder lose their courage, and not a few sink under the crisis. No feeding can sustain their accustomed strength, and the nourishment which formerly went to the production of young, is now absorbed in furnishing a supply to the growing plumage. When the feathers have attained their full size, the quill part, nearest the animal, grows harder, and thickens in its sides, but shrinks in its diameter, thus imbibing less nourishment, and becoming looser in the socket, till at length it falls out. The rudiments of an incipient quill are, meanwhile, unfolded beneath; for the skin, formed into a little sac, is fed from the body by a small vein and artery, and every day increases in size till it is protruded. While the one end is gradually developed into the *beard*, or *vane*, as it is termed, the portion attached to the skin is still soft, and receives a constant supply of nourishment, which is diffused through the body of the quill by means of the artery and vein. When, however, the quill has reached its full growth, the vein and artery insensibly diminish, until at last the small orifice by which they communicated with the quill is closed, and the circulation ceases. The quill, thus insulated from the system, continues for some months in the socket, till it begins to contract, and makes room for the repetition of the same process of nature. When the annual change of feathers takes place, the colour of the fresh plumage frequently differs from that of the old; and it is also well known, that several birds put on a different livery during the breeding season from that which they wear in autumn. But, in some instances, the full-grown feathers themselves change colour before they are replaced by new ones, a circumstance which has been particularly remarked of the mallard, the male chaffinch, the Swiss sandpiper, the dunlin, the black-headed gull, and the reed-bunting. Several females of the gallinaceous tribe assume, in old age, the attire of the male. Dr Paley, in his Natural Theology, has admirably illustrated the structure and properties of the feathers of birds, as a covering at once light, strong, and warm; but the passage is too long for our transcription, and we should be sorry to injure its effect by abridgment or mutilation.

An admirable contrivance has been provided for defending the feathers of birds from the moisture of the atmosphere, which they would otherwise constantly imbibe, and from the rain, which they would absorb in such quantity as to impede their flight. On the rump are two glands, in which an unctuous matter is constantly secreted, and from which it is occasionally pressed out by means of the bill, and used for the lubrification of the feathers. Such species as share the habitation of man, and live principally under cover, require a less copious supply of this fluid, and are, consequently, more slenderly provided with it than such as roam abroad; and hence poultry, when wetted, have a ruffled and uncomfortable appearance. Those, on the contrary, which haunt seas, lakes, and rivers, are furnished with a greater abundance of this sheathing liquid, just as those which reside in the colder latitudes are more liberally protected both by fat and down.

*Flight.*—Fitted up with all its apparatus of feathers and quills, a bird's wings become competent to the movements of the animal to which they are attached. Were the flapping of these instruments only the reciprocal motions of the same surfaces in opposite directions, the bird would lose as much by one motion as it gained by the other; but the surface of the wings, measured on the same plane, is contracted when the wings are drawn up, and let down to its full expansion when they descend on the air, for the purpose of moving the body by the reaction of that element. The form and structure of the wings, accordingly, their external convexity, the disposition and overlapping of their larger feathers, the play of the muscles and of the joints of the pinions, are all adapted to this alternation of shape and dimensions. The pinions, also, are so set on the body as to bring down the wings in an oblique direction towards the tail, which motion effects two purposes at the same time, namely, sustaining the body in the air, and propelling it forward. The steerage of a bird, in its flight, is accomplished partly by the wings, and in a principal degree by the tail. Long-legged birds, it has been observed, have short tails, and in their flight they place their legs close to their body, and stretch them out backwards as far as possible, and thus make them act like a rudder. The superior velocity with which aquatic birds swim under water, has not altogether escaped notice; but it is not entirely produced by the action of the wings, being considerably aided by the pressure of the superincumbent water. In swimming on the surface, a bird exerts two motions, one upward and the other forward, at every stroke of the feet, so that when covered with water, that force which was lost by the upward motion, is all directed to the progressive, and thus, like an otter, or water-rat, which swims much faster under the water than on its surface, it is enabled to escape from an enemy with accelerated speed. Conscious of this resource, it dives when pursued, or whenever dispatch is required, and rises to the surface only for renewed respiration.

Of the rate of the flight of birds in the air, various examples have been recorded. The common house-sparrow will fly more than 30 miles, and the eider-duck about 90 miles in an hour. A falcon, belonging to Henry II. king of France, and which escaped from Fountainbleau, is stated to have been found in Malta 24 hours after. As the distance, in this case, is computed to be no less than 1350 miles, as hawks do not fly in the night, and as this individual was probably not caught just on its arrival on the island, it is reasonable to suppose that it accomplished its passage in ten or twelve hours. A large bird, such as a kite or an eagle, has been known to disappear from the eye of the human observer in less than three minutes; from which we may infer, that it is capable of traversing more than 1500 yards in a minute, or 20 leagues in an hour. Colonel Montagu, indeed, in the Supplement to his Ornithological Dictionary, supposes that the rapidity with which a hawk and many other birds fly, is not less than at the rate of 100, or even of 150 miles an hour, and that if their utmost speed could be sustained for 10 successive days, they might, in that short period, make the tour of the world at the equator.

*Bill.*—Birds have neither lips nor teeth. Their *mandibles* are two pieces of a horny consistency, forming the *bill*, or *beak*. They are termed compressed when flattened horizontally, and *cuneated* when shaped like a wedge. The *rostrum*, or beak, is, moreover, said to be *subulate*, when awl-shaped; or straight and slender, or *cultrate*, when it has sharp edges; and *unguiculate*, when furnished with a nail at the end, as in the ducks. The naked skin, which covers the base of the bill, is denominated *cere*, or *cera*.

*Sense of smell.*—Above the bill, in many of the species, are two open canals, corresponding to the *nostrils* in other animals, and which, when very narrow, are termed *linear*. The olfactory nerves in this class are smaller in proportion, less numerous, and less expanded than in quadrupeds; and there is no provision of muscles for dilating or contracting the opening of the nostrils, as in the mammalia. In other species, the nostrils are imperforate. Their sense of smell, therefore, is, possibly, very imperfect; and although some of the rapacious kinds are said to scent carrion, and even gunpowder, at a considerable distance, the truth seems to be, that, in the one case, they are guided to their food, and, in the other, enabled to elude the fowler, chiefly by their superior powers of vision. According to Scarpa, the faculty of smell in birds is exactly proportioned to the extent of surface destined to the distribution of the olfactory nerves.

*Touch and taste.*—The sensations of touch and taste, also, are, probably, somewhat obtuse in most birds, because touch, as is well known, results from the immediate application of the skin to an object; and the feathered, or scaly nature of the skin of birds, will, necessarily, render all impressions of this kind very indistinct. The corneous texture of the beak, the scales on the upper parts of the feet and on the claws, and the hard and callous integument on their under side, should make these organs nearly insensible. The mouth, in like manner, which is the organ of taste, is lined with a hard and almost cartilaginous skin; and the tongue, whose point is sometimes, and whose base is always bony, is little calculated to receive or transmit very delicate or acute sensations of savour. As the wings and tail are merely instruments of motion, the feet and bill are the principal organs of touch. The climbing, rapacious, and passerine families, are supposed to have most feeling in their feet, whereas the waders and web-footed sorts, especially such of them as are furnished with long or broad bills for selecting their food, possess a considerable susceptibility in the beak, originating in the extent and distribution of the fifth pair of nerves. As the form and motions of the tongue of most species, seem to unfit that member for being applied with much nicety of discrimination, they are generally observed to swallow their food without examination, or any minute division of its parts: yet the structure of the tongue in ducks, parrots, and humming-birds, would seem to indicate the power of distinguishing certain degrees of relish.

*Hearing.*—We have every reason to believe, that the sense of hearing in birds considerably surpasses that of taste or touch; for, although these animals are unprovided with the *concha*, or that external projection of the ear which is observed in man and quadrupeds, yet the auditory cells of the cranium are analogous to the *mastoid* of the human subject; and, from their extent, they multiply sound much more in proportion. These cells are of the greatest magnitude in the nocturnal birds of prey, and in the goat-sucker; whilst in other species in which they are observed to diminish, or even, as in the parrot, to disappear, the cavity of the *tympanum*, as if by way of compensation, is posteriorly enlarged. The width of the eustachian tube, too, ought not to be overlooked.

*Song of birds.*—The facility with which many of the species retain and repeat sounds, and, in some cases, even articulate words, and the pleasure which they manifest in their varied warblings, bespeak, at once, capacity and delicacy of the auditory organs. The latter, in fact, as well as their instruments of utterance, are both more vigorous and flexible than those of quadrupeds. The mammalia, accordingly, are usually disposed to taciturnity; and their voice, which is only occasionally exerted, is, for the most part, uncouth and disagreeable to the human ear; whereas that of birds is generally characterized by sweetness and melody. The call of a few of the large species is, certainly, far from grateful, being limited to the repetition of one or a few harsh and discordant notes; but even then the preponderating power of voice is still abundantly obvious: Thus, the peacock, which, in respect of size, bears no proportion to the ox, is capable of extending its clamour to a greater distance. The loudest cries of wild or domestic quadrupeds are seldom heard beyond three quarters of a mile, and they are uttered in the densest regions of the atmosphere, which are best adapted to the propagation of sound; whereas the strains of birds that salute us from aloft, are uttered in a rarer medium, in which more effort is required to produce the same effect.

Independently of the strength and fleshiness of the pectoral muscles,—the greater comparative volume of the lungs,—their strong adhesion to the ribs and rump,—their ample provision of air-cells, and the greater vigour of the wind-pipe, which enable birds to excel other animals in the force and continuity of their voice;—they are, moreover, accommodated with certain peculiarities of conformation, by which to diversify and modulate their tones; for, at the lower end of the larynx, there is a contrivance somewhat analogous to the reed of a hautboy—so that a tuneful bird may, in fact, be regarded as a ventriloquist, the seat of song being in the breast.

The passion of love, and the feelings of contentment and joy, prompt the exercise of this fine adjustment of organs, while the nicety of the ear often enables the warbler to imitate, with success, the notes of others of its kind, of the human voice, or even of musical instruments. The Hon. Daines Barrington ingeniously contends, that the peculiar notes or songs of the different species of birds are altogether acquired, and no more innate than language is in man, the attempt of a nestling to sing corresponding with the imperfect endeavours of a child to talk. The first essay seems not to possess the slightest rudiments of the future song; but, as the bird grows older and stronger, it is not difficult to perceive its aim. In these attempts to form his song, when the scholar is once sure of a passage, he commonly raises his tone, which he again drops when he feels himself conscious of being unequal to the object of his trial. Should it appear unfavourable to the truth of this doctrine, that birds, in a wild state, so steadily adhere to the song of their own species, when so many others are to be heard around them, it is answered, that this circumstance arises from the attention paid by the nestling to the instructions of its own parent only, generally disregarding the notes of all the rest. The males of song birds, and many others, do not usually search for the female, but, perched on some conspicuous station, breathe out their amorous descants, which allure the females to the spot. The nightingale, for example, and most of its congeners, although timid and shy to a great degree, mount aloft to pour forth their moving strains, each seemingly vying with his neighbour, till the females arrive. The latter no sooner appear than fierce contests ensue; and the notes are considerably changed. Sometimes the song is hurried through, without the usual grace and elegance, and, at other times, modulated into a pleasing melody, the first being probably occasioned by the provocation of seeing another male, while the second may be regarded as an amatory lay. This variety of song lasts no longer than till the female is fixed in her choice, which usually happens a few days after her arrival; and, if the season proves favourable, she soon begins the task of nidification. When disturbed in his courtship, and separated from the sight of his mate, the male resumes his vociferous notes; but, if unmolested, he no longer sings so loud and frequently as before, attending with ridiculous gestures, and notes of peculiar softness, the female, in search of a secure nestling place; and, when she has selected a spot, he accompanies her in her flights to and from it, sitting on some neighbouring branch, while she arranges the small portion of materials which she fetches at intervals. When the construction is completed, and the eggs are deposited, incubation immediately takes place, and the male is again heard loud, but by no means so frequently as at first, never roaming beyond her hearing, and seldom from her sight; for, if she leaves her nest, he soon perceives it, and pursues her, occasionally uttering the soft notes of affection. When the brood come forth, he seems to be instantly apprized of it, ceases his tuneful glee, and appears to be wholly occupied in ministering to the nutrimental calls of his offspring, carrying to them food with the same assiduity as his mate, and often returning with the mutings of the young in his bill, that he may drop it at a distance from the nest. Ornithologists who have watched this interesting process with the greatest attention, have never been able to discover the parent birds giving their nascent progeny a musical lesson; and it is much to be questioned, if the late brood of many species ever hear the song of their parents, until they join in chorus, in the ensuing spring, when they also yield to the influence of the tender passion.

In the language of musicians, the song of birds is a succession of three or four different notes, which are continued, interruptedly, through the same intervals, in a bar of four crotchets, *adagio*, or whilst a pendulum swings four seconds. It has been remarked by some writers, that certain passages of the song, in a few species of birds, correspond with the intervals of our scale, of which, indeed, the cuckoo affords a striking and familiar instance: but by far the greatest part is not reducible to musical notation on account of the great rapidity of utterance, the uncertainty of pauses, the very high pitch of most birds, and the intervals being commonly so minute, when compared with the more gross ones into which we divide our octave, that we cannot appreciate them. Ordinary observers are apt to suppose, that all birds of the same species sing precisely the same notes and passages, which is by no means true, although there is a general resemblance; but the London bird-catchers, for example, who are conversant in the notes and passages of the different kinds, prefer the song of the Kentish goldfinch, and of the Essex chaffinch, while some of the nightingale fanciers prize a Surrey bird beyond one from Middlesex. The insectivorous tribes, too, it has been observed, have a more mellow, harmonious, and tender song than the graminivorous. The nightingale has been very generally esteemed the first of singing birds, and its acknowledged superiority chiefly consists in the greater mellowness of its tone, and its longer continuance of song, without a pause. Birds of richly diversified hues, it has been remarked, are deficient in respect of song: but this is not uniformly the case; for, to say nothing of the common goldfinch, which is very beautiful, and yet has a very melodious note, Dr Forster has observed, that "the wild forests of New Zealand, and the cultivated groves of Otaheite resound alike with the harmony of the shining songsters." The continuation of song in birds that undergo confinement, may be ascribed to exuberant feeding and artificial warmth, whereas wild birds have their stimulus abated by sexual intercourse, the occasional abridgement of food, and the reduced temperature of the season; for, though they are sometimes musical in the middle of winter, it is only in open and mild weather, when ready access to food and the genial heat of the sun exhilirate their frame.

*Sight.*—The faculty of vision possessed by birds is, in general, extensive and acute: we say *in general*, because some of them, as, for example, the owls, have more imperfect sight than most quadrupeds, at least during the day; at the same time, this apparent defect is the necessary consequence of a superior degree of sensibility in the organ of vision, which renders it more susceptible of being powerfully impressed by excess of light. The eyes of birds are especially distinguished by the additional membranes, the one external, and the other internal, the one situated in the great corner of the organ, forming a second, as it were, and more transparent eyelid, obedient to the will of the animal, and, obviously, destined both to wipe and clear the cornea, and to moderate any distressing intensity of light; and the other, seated in the bottom of the eye, being an expansion of the optic nerve, for the purpose of augmenting its sensibility to the rays of light proceeding from external objects. The first of these contrivances is termed the *nictitating* or *winking* membrane, which can, like a curtain, be drawn over the whole eye at pleasure, and through which, as a medium neither opake nor entirely pellucid, the eagle is said to gaze at the sun. It lies conveniently folded up in the corner of the eye, and performs its functions with the utmost promptitude, sweeping the whole organ in an instant, and diffusing over it the lachrymal humour, being, in fact, an elastic substance, readily drawn out, and as readily receding into its former position. By a fine, but strong thread, or tendon, it is connected with a muscle in the back part of the eye, where it is not only secure, but out of the way of the other functions of the organ. The second piece of peculiar mechanism, to which we have alluded, seems to have been first distinctly ascertained by those of the Parisian academicians, who communicated to the public much useful information in their *Mémoires pour servir à l'Histoire Naturelle des Animaux*. On examining the eyes of a turkey, they observed that the optic nerve, which is situated much to a side, after piercing the sclerotic and choroid, enlarged into a round form, and gave out from its circumference several black filaments, uniting into a membrane, which was, afterwards, found in the eyes of all the birds which they submitted to inspection, though, in some instances, variously modified. Owing, most probably, to this expansion of the optic nerve, combined with their rapid movements, which habituate them to immediate comparisons of distances, the greater number of birds enjoy the sense of sight in a pre-eminent degree. A sparrow-hawk, for example, discerns a lark on a clod of earth at twenty times a greater distance than a man or a dog can perceive it; and a kite, when soaring beyond the human view, discovers, nevertheless, small lizards, field-mice, birds, &c. and, with wonderful accuracy, selects those on which it means to pounce, because, the organ being, at once, very flexible and very sensible, swells or

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flattens, is covered or uncovered, contracts and enlarges, assumes, in short, quickly, and alternately, all the forms that are most proper for acting and for seeing, in the greatest perfection, in various lights, and at different distances. The ball of the eye, too, in birds, is larger in proportion to the size of the head, than in man or quadrupeds; that of a female eagle, for instance, was found by the Parisian academicians, to measure an inch and a half in the direction of its longest axis, that of the ibis six lines, and that of the stork twenty-four lines.

Such physical resources, then, as are more immediately connected with superior powers of vision, may safely be ascribed to the feathered tribe. Besides, the developement of these resources may, we presume, be considerably aided by the nature of the element in which they principally reside, and the readiness with which they can traverse it in all directions. A bird, possibly, knows better than man, all the degrees of the resistance of the air, its temperature at different heights, and the relative changes of its pressure, anticipating, with greater certainty than we can pretend to, the approaching alterations of the atmosphere; for, a thousand and a thousand times, it must have measured its strength with that of the wind, or availed itself of its aid, in order to increase the rapidity or the length of its flight. Hence, the restless, roaming, and shrill clamour of some of the species, portend a storm; and hence, when the strife of elements is about to cease, the littoral kinds no longer expose their wetted plumage to the solar rays, the owl suspends her lugubrious note, and the crows express their gladness by noisy acclamations. The arrival of the snow-bunting is, in our climate, usually co-incident with the rigour of the cold season: the Bohemian chatterer admonishes us of the first approaches of frost; and the stork, in "the heavens, knoweth her appointed times; and the turtle, and the crane, and the swallow, observe the time of their coming."

*Bones.*—If we next direct our attention to the internal structure of birds, we shall find it also admirably adapted to the circumstances of their condition. In the bones of an animal destined for flight, the two qualities peculiarly requisite are strength and lightness; hence the cavities of the bones of birds are much larger, in proportion to the weight of the bone, than in those of quadrupeds; secondly, these cavities are empty; and, thirdly, the fabric is of a firmer texture than the substance of other bones. Now, the weight being the same, the diameter, it is evident, must be greater in a hollow bone than in a solid one, and, with the diameter, the strength of the cylinder will, *caeteris paribus,* increase. A bone, in short, of the same weight, would not have been so strong in any other form; and to have made it heavier, would have incommoded flight. The muscles, too, with the exception of those appropriated to the movements of the wings, are extremely light and delicate.

*Lungs.*—The lungs are placed close to the backbone and ribs; and the air, entering into these, by a communication from the wind-pipe, passes through and is conveyed into a number of membranous cells, which lie on the sides of the pericardium, and are connected with those of the sternum. In some species, these cells are continued down the wings, and extend even to the pinions, thigh-bones, and other parts of the body, which may be filled and distended with the air at the animal's pleasure. The almost universal diffusion of this fluid in the bodies of birds is of infinite use to them, not only in their long and laborious flights, but likewise in preventing their respiration from being stopped or interrupted, by the rapidity of their motion through a resisting medium. Were it possible for man to move with the swiftness of a swallow, the actual resistance of the air, would, as he is unprovided with internal reservoirs, similar to those of birds, quickly suffocate him. Owing, also, to the comparative amplitude of their breathing system, birds respire more copiously than quadrupeds, experiment having proved that two sparrows consume as much pure air as a Guinea-pig.

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*Oesophagus.*—The oesophagus, or gullet, is not situated exactly on the fore part of the neck, but a little on the right side, is partially covered by the trachea or wind-pipe, and is connected with all the neighbouring parts by a loose cellular substance; in consequence of which, and of its inclination to one side, when the neck is much bent, it does not take the same degree of flexure, as is best exemplified in some of the waders and the water birds. It has, moreover, been observed, that the form of the oesophagus varies according to the habits of the bird and the nature of its food, being, in the rapacious and piscivorous kinds, of great capacity throughout its length. This enlargement of the gullet not only enables these birds to swallow their prey entire, but answers the purpose of a repository for their food, and thus counterbalances the disadvantages proceeding from their precarious mode of subsistence. Herons, accordingly, the cormorant, spoon-bill, &c. will snap up as much fish at once as will suffice to support them for a considerable time; and an owl is often obliged to exist for weeks on a mouse or rat, which is conveyed by degrees into the stomach, until the whole is digested. All the piscivorous species have the oesophagus widest at its commencement, or next the fauces, for the more commodious descent of their prey; and the pelican furnishes a most remarkable instance of dilatation of the fauces, in its gular pouch. The *crop,* or *craw,* is a term applied to another sort of dilatation of the œsophagus. When this enlargement is single, it is situated on the right side of the gullet, and placed so low on the neck that a portion of the bag is accommodated in the space left at the upper region of the thorax, within the forked bone. Its form is generally globular, but rendered somewhat irregular from its connection with the œsophagus, which enters at the superior part, and appears again on the middle. The effect of this structure is, obviously, not only to receive a greater quantity of food than can be digested at once, but also to retain it until it has undergone some change. The birds which are furnished with a crop of the figure just described usually feed on grain, or other hard substances, which require to be softened by maceration in the mucous secretion of the œsophagus, as, for example, the pheasant, common domestic fowl, pintado, turkey, &c. In the pigeon tribe, the œsophagus is of great capacity from its very commencement, and at the lower portion it swells out into two large sacs, between which and the stomach it is considerably contracted. This double crop is more necessary to the pigeon than to other birds, both because its food requires long maceration, and because the young, and even, on some occasions, the mature females, draw their subsistence from this repository.

*Food.*—Birds, like quadrupeds, may be divided into granivorous and carnivorous, the former being furnished with larger intestines than the latter. Their food, which consists of grain of various sorts, is conveyed entire into the first stomach, or crop, where it undergoes a partial dilution, in a liquor secreted from the glands, and spread over its surface. It is then received into another species of stomach, in which it is further diluted; after which it is transmitted into the gizzard, or true stomach, consisting of two very strong muscles, externally coated with a tendinous substance, and lined with a thick membrane, of great strength and power; and in this organ it is completely triturated, and prepared for the operation of the gastric juice. With a view to ascertain the force of action manifested by the apparatus which we have described, Spallanzani had recourse to a great variety of experiments. Tin tubes filled with grain were thrust into the stomachs of turkeys, and, after remaining twenty-four hours, were found to be broken, compressed, and distorted in the most irregular manner. In the same space of time, the stomach of a cock had broken off the angles of a piece of rough jagged glass, although, on examining the gizzard, no wound or laceration could be perceived. A ball of lead, in which were fixed twelve strong needles, with their points projecting about a quarter of an inch from the surface, and the whole covered with a case of paper, having been forced down the throat of a turkey, the bird retained it a day and a half without betraying any symptoms of uneasiness; and the points of all the needles were found broken off close to the surface of the ball, except two or three, whose stumps still projected a little. Again, a dozen of small and very sharp lancets were inserted in a leaden ball, which was given in the same manner to a turkey cock, and allowed to remain eight hours in its stomach; but, on opening the latter, nothing appeared but the naked ball, the lancets having been broken in pieces, while the stomach remained sound and entire. The experiments, however, by which he endeavours to shew, that the pebbles so often found in the stomachs of various birds are not swallowed for the purpose of aiding digestion, are by no means decisive of the question, besides that they are at variance with one another, and, we may add, with common observation; for it is a well known fact, that the birds do not thrive when they cannot obtain such pebbles, and that the parent even provides them for the young before the latter quit the nest. Our experimentalist himself acknowledges that he could not perceive any bird so young that it had not some stones in its gizzard, and he was therefore obliged to rear pigeons and turkeys from the shell before he could procure them free from them. So far from swallowing small stones from keenness of appetite, or from mistaking them for food, birds seek out and select those which are most suited to their purpose, and which are generally bits of quartz, of a pretty equal size, and roundish figure, with many small sharp angles. Some of the larger species, as those of the struthious kind, the bustard, &c., are in the habit of swallowing pieces of metal and coins, which necessarily suffer reduction by the friction to which they are exposed; and hence has originated the ridiculous notion of the ostrich digesting iron. We may reasonably infer, then, that the extraneous bodies found in the gizzard are required for the perfect division of the food which is used by the birds that have recourse to them. Such extraneous bodies are proportioned in quantity to the degree of muscularity with which the ventricle is endowed, and the nutritive quality of the food; but birds which have thin stomachs, and are carnivorous, never designedly swallow stones or other indigestible substances.

With a view to ascertain the mode of operation of the gizzard of the living subject, Reaumur opened several fowls during the process of digestion, and in one instance only observed alternate contractions and dilatations of the part, slowly and gradually performed. Spallanzani was scarcely more successful, having been seldom able to detect any motion at all, and, when he did, it was always irregular, partial, and indistinct, owing, no doubt, in part, to the violence committed by opening the body, but also to the disposition of the fibres in the interior of the digestive muscle, which are calculated not for performing extensive motions, but for exerting a vigorous concentrating force on whatever may be subjected to their operation.

No very satisfactory experiments have hitherto been instituted on the digestive fluid of birds. When expressed from the gastric glands, which is the only mode of obtaining it pure, it is observed to be of a cinereous, or pale yellow colour, turbid, and of a tenacity like mucus. According to Spallanzani, it has, in several instances, a bitter and salt savour, which he attributes to admixture with some of the fluids contained in the intestines. The turbidness and the colour were, he found, produced by the presence of countless yellow particles, too minute to be distinctly seen without the aid of the microscope, and which, subsiding in a few hours to the bottom, left the supernatant liquor as transparent as water. He had also remarked, that the tinge varied in shade and intensity according to the species, being in the eagle, for example, cinereous, and in the crow of a reddish yellow, like the yolk of an egg. From his experiments we may infer, that the gastric juice of birds is capable of resisting the effects of cold more than common fluids, or even than those impregnated with a quantity of salt. The gastric fluid of the crow has been submitted to chemical examination by Scopoli, who reports, that it contains a portion of gelatine and saponaceous substance, some muriate of ammonia, phosphate of lime, and a large proportion of water.

*Extent and energy of the respiratory system.*—As the lungs of birds are attached to the breast itself, no diaphragm constrains their action in the thoracic cavity; two sacs, or air-pouches, are placed in the abdominal region; and canals circulate the air through the whole corporeal frame, not excepting the interior bones, the cellular texture, the first stomach, and the feathers. They are, in short, penetrated by air. Hence, it is reasonable to presume, that they will live a shorter time than quadrupeds of the same bulk in a limited atmosphere, because they more speedily exhaust all its portion of oxygen. As animal heat also is augmented by intensity of respiration, the temperature of a bird's body is uniformly superior to that of most animals, and surpasses our own by two or three degrees. To the same cause, combined with the warmth of their covering, we may ascribe the capacity manifested by some of the smaller species of resisting the severest colds of our northern winters, the ardour, inconstancy, and turbulent vivacity of most of the class, as well as the petulance of their character. Their maladies, in like manner, are generally of an acute, violent, inflammatory, or nervous description; their passions are excessive, and a trifling circumstance will irritate their sensitive frame. With the exception of the rapacious sorts, which gorge themselves with blood, almost all birds require water to temper their ardency of constitution, although they secrete very little urine, are destitute of a bladder, and discharge the scanty contents of the urethra by the common vent.

*Appetite.*—Their appetite, if compared with that of quadrupeds, is very vehement, because their digestion is very rapid. In their search for food, the granivorous sorts consume all the intervals that are not devoted to sleep and breeding. But the aquatic and swimming families are particularly voracious; for various gulls, penguins, some of the larger puffins, albatrosses, &c. penetrate, with eager glance, the stormy waves, and pursue a timid prey, or pounce, like famished harpies, on huge whales, mangling their living flesh, or tearing, with doleful screams, oily and bleeding morsels of seals, which the fury of the tempest may have driven on the strand.

*Migration.*—Without the means of conveying themselves, with great swiftness, from place to place, birds could not easily subsist, the food which nature has provided for them being so irregularly distributed that they are constrained to take long journeys, in order to secure the necessary supplies. Hence one principal cause of those migrations which so many species statedly perform. That defect of aliment, rather than of warmth, urges so many families of the feathered race to shift their residence, with the change of seasons, might be made obvious, from various considerations; for the birds of passage, as they are called, are chiefly those whose nourishment fails at the period of their departure. Some of the more tender and delicate kinds can brave intense cold; and the moving squadrons frequently prosecute their way at such a height in the atmosphere, that they must experience a much greater degree of cold than if they steered their course near the surface of the earth. Besides a failure of food, however, the want of a proper temperature, and of a convenient situation for the important business of breeding and rearing their offspring, may influence not a few. Some species remain permanently in one part of the world, as the sparrow, rook, magpie, owl, and most of the rapacious sorts; others change their residence in the same country, and shift their quarters, without travelling to any great distance, as the wagtail, red-breast, wild duck, and wild goose, which, on the approach of winter, repair to the southern districts of our island; others, again, as the gannet, black-cap, cuckoo, swallow, and various kinds of land and water-fowl, cross the seas, and roam to far distant countries; and to these latter, the epithet *migratory* has been usually applied. Some birds which are stationary in one country, as the kite, for instance, are migratory in another, as the same species in Egypt.

British migratory birds may be conveniently divided into those which inhabit the island in the winter time, as field-fares, wood-cocks, and many sea birds, and into those which, coming in spring, spend the summer with us, as the cuckoo, wry-neck, redstart, swallow, &c. The seasons of their migrations are observed with wonderful order and punctuality; but the secrecy with which immense flocks take their departure, and the suddenness with which they reappear, are not easily explained. We are, also, apt to suppose, that, during long flights over extensive tracts of water, the means of subsistence would inevitably fail, without reflecting on the superior velocity with which birds are carried forward in the air, and the ease with which they continue their exertions for a much longer time than can be done by the stoutest quadruped. Our swiftest horses go at the rate of a mile in somewhat less than two minutes; and there is, we believe, a solitary instance on record, of one which went at the rate of nearly a mile in the minute, but only for a single second. In such cases, the extraordinary effort has been attended with debility, and the incapacity of maintaining the same degree of exertion; but the motions of birds are not impeded by similar causes, and they not only glide through the air with surprising rapidity, but can continue on wing, and with equal speed, for a considerable length of time. If, then, we suppose one of them to fly at the rate of only half a mile in a minute, for the space of 24 hours, it will, in that time, traverse an extent of 700 miles, which is sufficient to account for almost the longest migration; or, if aided by a favourable current of air, there is reason to believe that it would perform the same journey much sooner. Many of them, too, have it in their power to skirt along coasts, or to cross narrow channels of the sea, so as to repose, at intervals, during their progress. Thus, both in spring, and at the fall, myriads of the swallow tribe, bee-birds, hoopoes, golden thrushes, and other soft-billed summer birds of passage, traverse the straights of Gibraltar, from north to south, or from south to north, according to the season. Now, on casting an eye on the map, we may be readily convinced, that a bird may travel from Great Britain to the equator, without exposing itself to boundless seas, merely by crossing the water at Dover, and again at Gibraltar. At the latter stage, the swallows are observed to be economical of their flight, for they direct their course, in little detached parties of six or seven, at the narrowest passage which they can find, usually slanting across the bay to the south-west, and so

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passing over to Tangier, which, it seems, is really the nearest line. The course of the season again regulates the return of these migrants; for, whether it be that they have exhausted the means of their favourite subsistence, or that they conceive a longing for their native homes, they uniformly return to breed, and generally in the same spots which they haunted in preceding years. Spallanzani having suspected this local attachment in the swallow, tied a red thread to the feet of several of them which had nestled in his windows, and recognized them, by this mark, occupying their former stations in the following year. Besides, we may presume, that many of these birds proceed from country to country by deliberate steps, and nearly in proportion to the advance or retrocession of their living food; and, if so, we are no longer reduced to the necessity of supposing any wonderful stretch of flight across enormous tracts of sea or land.

Few subjects, however, have more engaged the attention of naturalists, than the brumal retreat of the swallow tribes. Some, like Pliny, have imagined that these birds, on the approach of winter, retire to the inmost recesses of rock and mountains, and that they there remain in a torpid state till spring; whilst others have not only conjectured, but asserted, that they immerse themselves in the water, and continue dormant at the bottom, until they are again called forth by the vernal sun. They have been found, it is alleged, in lakes and rivers, in whole clusters, mouth to mouth, wing to wing, and foot to foot. Klein is even more minutely romantic, for he gravely talks of their assembling in bands, and clinging to a reed, till it breaks and sinks with them to the bottom. Nay, he informs us, that their submersion is preceded by a song or dirge, which lasts more than a quarter of an hour;—that they sometimes lay hold of a straw with their bills, and plunge down in company; and that others adhere to one another by the feet, and thus consign themselves to their humid residence. It requires, surely, no extraordinary stretch of reason, to shew the physical impossibility of a body specifically lighter than water undergoing immersion by means of a body lighter than itself. Mr John Hunter's dissections and observations, moreover, convinced that ingenious physiologist, that swallows are incapable of remaining under water, for any length of time, without being drowned. A few straggling instances of some of the later broods taking shelter among the reeds of lakes or rivers, may possibly have given rise to the exaggerated tales of their statedly retiring to the bottom of waters.

That by far the greater number of our *hirundines* actually migrate, is a truth so well established by facts, that we can no longer reasonably call it in question. If these birds lay concealed in winter in the same countries which they inhabit in summer, they would, probably, make their first appearance in spring, in mild weather, and sooner in early than in late seasons, which is not confirmed by experience. But the most direct argument in favour of their migration, is derived from the accounts of mariners, and others, who have seen them on their passage many hundred miles out at sea, and on whose ships they have alighted to rest, almost exhausted with fatigue and hunger. Adanson, in his voyage to Senegal, relates, that on the 6th of October, being about 50 leagues from the coast, between the island of Goree and Senegal, four swallows alighted on the shrouds of his ship, which he easily caught, and knew to be European swallows. He adds, that these birds never appear in Senegal but in the winter season, and that they do not build nests, as in Europe, but roost every night on the sand, by the seashore. Sir Charles Wager relates, that, on one of his voyages home, as he came into soundings in the English channel, a great flock of swallows settled on his rigging; every rope was covered with them; they hung on one another, like a swarm of bees, filling even the decks and the carvings. Though apparently spent and famished, yet, when recruited by a night's rest, they resumed their flight in the morning. Mr Peter Collinson, in a letter to Klein, mentions, that a similar circumstance occurred in the course of Captain Wright's voyage from Philadelphia to London. Sea-faring people, indeed, frequently assure us, that they have met with swallows at some hundred miles from land, when it is reasonable to presume they were on their passage from some distant country. Again, if they uniformly appear in Senegal, when they disappear in almost every country of Europe, and at no other time; and, if they regularly appear in Europe, when they disappear in Senegal, as Adanson asserts to be the case,—we may confidently infer, that the latter country, and the other warm regions of Africa, on the one hand, and the cold and temperate districts of Europe and Asia, on the other, are, alternately, inhabited by the same birds. But this will appear still more evident, when it is considered, that the same causes which contribute to drive them from the northern and temperate quarters of Europe and Asia, namely, rigorous weather and scarcity of food, do not exist in Senegal and other tropical latitudes.

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Although the annual disappearance of these birds from our own island is seldom distinctly noted, as it may frequently take place during the night, and at considerable heights in the atmosphere, yet it has been witnessed, with more or less accuracy, by curious observers. Thus, Mr Collinson, whom we have already quoted, when writing on the subject, makes use of the following expressions: "I have for many years been very watchful in taking notice of the times when the swallows leave us, and I think I have twice actually seen them taking their flight. At two different years, (on the 27th and 29th of September) walking in my garden at noon, on very sunshiny days, and looking up into the sky, I distinctly saw an innumerable number of swallows, soaring round and round, higher and higher, until my eyes were so pained with looking at them, that I could no longer discern them." Mr White of Selborne relates, that, as he was travelling, very early on a morning of Michaelmas day, and arriving on a large heath, or common, he could discern, as a thick mist, which had obscured the prospect, began to dissipate, great numbers of swallows clustering on the stunted shrubs and bushes, as if they had roosted there all night. As soon as the air became clear and pleasant, they all were on the wing at once, and, by a placid and easy flight, proceeded on southward, towards the sea; after which, he could perceive no more flocks, but only an occasional straggler. Hence, he was induced to believe, that they disappear in multitudes, and not gradually, as some have alleged. From various observations, he was likewise inclined to accede to the idea of some of the more weakly being left behind, laying themselves up, and emerging from their retreats in a warm day. At Oxford, he remarks, they are seen later than elsewhere in England, a circumstance which, he insinuates, may be owing to the number of massy buildings at that place, or to the adjacent streams.

Before we dismiss the subject of the migration of swallows, we should notice those frequent meetings which precede their departure, and in which the rapid and various clattering possibly denotes the concert of measures for the prosecution of their approaching journey. In these meetings, it is not improbable that the new race receive their instructions, while the later broods, incapable of protracted flight, are left behind, and either betake themselves to some close retreat, or perish from cold, or privation of food. A few exceptions, however, do not invalidate a general rule. But that a summer bird of passage may, in consequence of disease, or of a late brood, have been prevented from resorting to its winter quarters, may be readily conceived; and there are well-attested instances of the swallow and martin having been observed flying in winter, apparently roused by an unusual warmth of the air. Examples likewise occur of some of our winter migrants remaining with us throughout the summer; for the eggs and the young of the woodcock have been found in our forests: but these are individual and accidental cases, which are noted on account of their rarity. Did all the reputed migratory species really reside with us the whole year, whether in a torpid state or no, we should have daily proofs of the fact, instead of a few insulated and extraordinary relations. That any species of bird regularly hybernates, is at least very improbable, and has never been proved.

Further, that our summer migrants come to us from the south, and our winter ones from the north, scarcely admits of doubt; but by what sensations, or principles, their passage is so unerringly effected, we pretend not to explain. Another mysterious circumstance in the history of our summer birds of passage is, that the males precede the other sex in their vernal flight. It is also presumed that, immediately on their arrival, they are conscious of the impulse of love; for, if the weather be moderate and warm, they are incessant in their song or call. With respect to the rice-bird, we are informed, that the females only migrate to Carolina. In Sweden, too, there is a species of duck, of which the males leave the country at the time of incubation, and do not return till the pairing season.

Numerous species of water fowls annually resort from various parts of Europe to the wastes and lakes of Lapland, and other arctic regions, there to perform, in full security, the important functions of breeding. They and their young quit their northern haunts in September, and are speedily diffused over the more temperate regions, making their appearance with us about the beginning of October, circulating at first round our shores, and, when urged by severe frosts, betaking themselves to our lakes and rivers. Of the web-footed birds, some have more hardy constitutions than others, and are enabled to endure the more ordinary winters of the polar circle; but, when the cold presses on them with more than usual intensity, they repair to our more moderate latitudes. Few of them, however, abide with us during the breeding season, the greater number being then traceable to Lapland—a country of rivers, lakes, marshes, and hills, and more or less invested with dark and dense forests. There, too, in summer, the soil remains moist for woodcocks and other slender-billed birds, while the waters afford innumerable larvæ, especially of gnats, and the long days and meteoric nights offer to the feathered race abundant opportunities of collecting so minute a food, in districts very sparingly peopled with human beings. Wherefore, then, should Linnæus express his astonishment at the legions of aquatic fowls which migrated with him out of Lapland, which exceeded in number the host of Xerxes, and covered for eight entire days and nights the surface of the river Calix. The sources of vegetable aliment, it is true, are scantily distributed in these hyperborean wastes; but, for the birds which frequent them, their all-bountiful Creator has spread an ample table of insect food. The desire of security, not less than the defect of nourishment, doubtless, prompts many of the shy and timid species to resort to tranquil retreats. When large portions of our own island presented little else than trackless woods and swamps, many of these fowls remained with us throughout the year: thus, the egret, a species of heron, now scarcely known in Great Britain, was, in former times, extremely common; and the crane, which has quite forsaken us, once bred familiarly in our marshes. As the arts of husbandry extend and multiply, these coy families are more and more molested, till at last they remove to some more lonely residence. Those, on the contrary, which nestle in almost inaccessible rocks, impending over our shores, still continue to haunt the same recesses.

The passage of immense flocks of quails, in an easterly direction, and to the shores of Africa, was witnessed by honest Belon three centuries ago. Towards the end of autumn, indeed, they move in such multitudes, that the inhabitants of the Greek islands take them by thousands, and, being unable to consume them at once, preserve them in vessels filled with melted fat.

From the observations of the younger M. Baillon, who has paid particular attention to this department of ornithology, it should seem, that migratory birds are regulated in their movements by the direction of the wind, a precaution which is necessary to prevent their being driven on an adverse or desolate coast, or dispersed over a boundless ocean. The godwits, lapwings, curlews, and other littoral species, accordingly, never arrive on the shores of the Somme, in France, but with a north-easterly, easterly, or south-easterly wind; whereas, in passing to the coast of England, they avail themselves of a westerly, or northerly breeze, tacking against the prevailing current of air, that they may not be driven out to sea.

We should remark, also, that the modes and hours of journeying vary among the different species. Thus, some, as wild-ducks, sheldrakes, &c. assemble in numerous bands; the cranes move in long triangular companies, and at a great height, the better to overcome the resistance of the air; and the wild geese proceed in angular lines, each individual in turn acting as a leader. Most of the little seminivorous and baccivorous kinds advance in flocks, and by short stages; some, as the buntings, finches, ortolans, &c. uniting in families, and others, as the blue jays, rice-birds, larks, &c. separating into detached parties. Some, again, as certain descriptions of fly-catchers, on account of the difficulty of procuring provisions by the way, form little travelling groups of ten or twelve; and others which require a large portion of insect food, perform their stated roamings in solitude. Some species set off in detachments, consisting wholly either of males or females, the former generally taking the lead, as is exemplified in the history of the common chaffinch. Different sorts of small birds, as finches and swallows, have been observed to arrive in numerous bands, although they possibly departed in limited companies, having been joined, apparently during their passage, by other squadrons. The predacious tribes do not naturally travel in a social state, but hang on the rear of others, on which they prey. Cranes, woodcocks, sanderlings, godwits, &c. start in the evening, or with the first approach of the dawn, shunning the glare of broad day, and preferring a dun or clouded atmosphere. The rice-birds travel during the night, and repose during the day. It is chiefly in the mornings that jays, buntings, and finches congregate in flocks; they then disperse for the day, and re-assemble in the evening, that they may resume their journey in detachments on the day following.

Some birds migrate from a country to which they do not return, at least during a long term of years, of which we have a singular example in the magpie. Upwards of seventy years ago, some of this species seem to have migrated from Scotland to Ireland, and they are now as numerous in the latter as in the former country. A similar spirit of colonization has been observed among the wood-larks, some districts of country being now frequented by them where formerly they never appeared. Again, some migrants leave a country one year and are stationary in another. Thus, the common wild-duck remains in Sweden during a temperate winter, but quits it in a severe one, being, in the latter case, impelled by want of food; and it is possibly owing to the same cause, that the wild-goose, which, in Sweden, is only a summer bird, is stationary in the north of Scotland. The sky-lark remains the whole year in the last-mentioned country, although it is a bird of passage in Minorca; and in England the snipe is migratory, whereas in Scotland it is stationary. Some birds obviously travel in quest of a particular description of food: thus, during the rice-harvest in Cuba, the rice-bird occurs in great multitudes, but the crop is no sooner gathered than it wings its way to Carolina, where it in like manner remains till the grain is removed from the fields. Another peculiarity in some migrants is the circumstance of their observing a different route, while repairing to winter quarters, from that by which they return, as is exemplified by the passenger pigeons in North America. In their transit from Canada, the scene of their breeding, to Carolina, they perch on the trees in Virginia during the night, many of the branches being broken by the weight of the crowds that alight on them, a circumstance which marks their course to the people of the interior, who support themselves by killing them; but, on their return to Canada in the spring, their track is altogether unknown.

The late Colonel Montagu remarked, that migrative birds are much more confined in their longitudinal than in their latitudinal range, and that, consequently, many species pass through France and Germany in the spring, and return in the autumn, which have not hitherto been observed to wander into this country, although they advance much farther north than any part of Great Britain. Others, again, from accidental causes, of which we have no certain knowledge, occasionally deviate a little from their ordinary steerage, and are met with solitary in this island, as the black stork. According to the same intelligent naturalist, when birds travel in company during the night, they are kept together by some well-known cry.

The return of the same families to the same haunts is one of the most striking facts in the history of the migration of birds. We have already alluded to Spallanzani's simple experiment, by which he satisfied himself as to the accuracy of this particular with respect to the swallow. Redi mentions, that he had seen the cranes pursuing the same route, and alighting on the same spots, at the same periods of the year. A lame starling, according to Esmark, bred for eight consecutive years in the same hole of an old alder. The storks resume their appropriate stations on the roofs of houses in Holland; and two pretty wagtails were in the habit of nestling for years in a laurel in the garden of Linnæus.

*Nidification.*—The nests of birds are generally constructed with a degree of neatness, art, and skill that is truly astonishing. In the collection of the materials the female is often assisted by the male, but the construction of the nest most frequently devolves on herself. Both may sometimes be observed fetching sticks, moss, straws, &c. to the destined spot, to form the foundation and the exterior of the little interesting fabric, and hair, wool, feathers, or the down of animals and plants, with which to make a soft, warm, and comfortable bed for the young. The outside of the nest frequently bears such a resemblance in colour to the surrounding foliage or branches as not readily to be discovered. By laying down on the same spot parcels of hay, straw, moss, hair, cotton, feathers, &c., a person in the country may enjoy the pleasure of watching the feathered architects, which will flock to this magazine, and select each for itself the substances most suited to its purpose, or fight with one another for the object of a common choice. All birds, however, do not construct their nests with the same care and industry;

for some are satisfied with scratching the earth, in which they deposit their eggs, without any farther preparation; others merely cover a few sticks with leaves; and some lay their eggs in the dust of decayed timber. The cuckoo and the cowpen-bird consign the duties of incubating and rearing their offspring to the care of a bird of another species, into whose nest they intrude their eggs. But to specify the modes of nestling appropriate to the respective species, would lead us far beyond the limits assigned to the present article.

*Oviparous production.*—All birds are *oviparous*, or, in other words, produce eggs, from which, in consequence of the process of incubation, the young are extruded. The growth of an egg after impregnation is extremely rapid; but the *vitellus*, or yolk only is formed in the ovarium, in which it remains till within twenty-four hours of being produced, when that part being matured, separates and falls down the oviduct into the uterus, where the egg is perfected, the yolk being first covered with the *albumen*, or white, and, lastly, the whole invested with a calcareous shell. The form of the egg seems to result from the pressure which it sustains in the different parts through which it passes. In most cases, only one vitellus separates from the ovary at a time, until the exclusion of which no other succeeds; and as this, with a few exceptions, is a daily process, the shell and albumen are formed in twenty-four hours. A bubble of air is present at the large end between the shell and the interior skin; and, from the warmth communicated by the sitting bird to this confined air, the elasticity of the latter is supposed to be increased beyond its natural tenor, and its parts, at the same time, put into motion by the gentle rarefaction, so as to contribute to the gradual promotion of the growth of the young. When housewives suspect the soundness of an egg, they will put their tongue to the broad end of it, and if it is not warm they conclude that it is either putrid or addled.

As the course of nature is sometimes obstructed by remote or accidental causes, imperfect or monstrous eggs of different descriptions are sometimes produced, although such anomalies are possibly of more frequent occurrence among domestic poultry than among birds in a wild state. A yolkless, or, as it is sometimes called, a *cock's egg*, has been termed also *centininum ovum*, from the foolish notion that it was the hundredth, or the last the bird could lay. Others, again, contain two yolks, or are furnished with double shells, or want the calcareous covering, being merely wrapt in a soft pliable skin like vellum. To account for these irregularities, we may conceive that a defect exists at the time in some part of the animal's body; and as the vitellus and the abdomen derive their formation from different parts, the want of a yolk may perhaps be traced to some derangement of the ovarium. We may suppose an unequal stimulus in the parts destined to the maturation of the egg, so as that the growth of the vitellus may not coincide with that of the albumen; or the vesicles appropriated to the collection, preparation, and union of the organic particles of the albumen in the uterus, may have all their powers effective, while the energies of those of the ovary may be weakened, suspended, or destroyed. When, on the contrary, the developement of the vitellus is too luxuriant, two yolks pass the oviduct together, and being surrounded by the usual quantity of albumen, come forth in the form of a single egg, but of somewhat larger dimensions than ordinary. From these twins are occasionally produced, but more frequently deformities, which are seldom hatched. The superabundance of organic particles may, in like manner, occasion the detachment of an egg from the ovary without male contact, and may thus give rise to those addled eggs which are sometimes found in nests. At other times, the egg finds its way into the oviduct, and receives its due portion of albumen, but is deposited without any calcareous covering, the elements of the carbonate of lime having been either wanting in the system, or too slowly secreted to form the shell, as happens more particularly to fowls that lay for the first time. There are likewise instances of the egg having acquired such dimensions in the oviduct, that its exclusion could not be effected but at the expence of the mother's life. In the year 1718, M. Morand, surgeon to the corps of invalids, at Paris, found a monstrous egg in the body of a young hen, which did not breed, and which had fallen into a state of langour. This egg weighed twelve ounces; the white was hardened, as if it had been boiled, and was composed of no fewer than thirty-six distinct layers, while the yolk was more liquid than usual, and of a paler colour. In 1742, M. Petit exhibited an oviform body, found in the white of an egg. Of its four coatings, the outermost was pretty solid, but the fourth having opened, allowed a fluid, like the white of an egg, to escape. The country people believe that cocks sometimes lay small eggs, without a yolk, and that, when these are hatched in dung, they give birth to a sort of serpent, called *basilisk*, or *cockatrice*. A cock, accused of this talent, in the presence of Lapeyronie, was dissected by that eminent surgeon, who demonstrated that it had neither eggs, nor ovaries; and his mate, in consequence of some mal-conformation, was discovered to lay the same description of eggs. Yet, after all, ought we to regard such appearances as real deviations from the laws of nature, and not rather as necessary consequences of those very laws? It may be a fixed and established institution in the animal economy, that a certain combination of circumstances is indispensable to perfect reproduction; but it will also follow, in course, that excess or defect, in any part of the combination, will vary, modify, or intercept the result which might have, otherwise, been confidently anticipated.

All birds of the same species lay nearly a determinate number of eggs; but, by withdrawing them, in proportion as they are deposited, a greater number than usual may often be procured. The eggs of water-fowls are generally larger than those of the land species, and have darker coloured yolks; they are, also, less agreeable to the taste.

The external calcareous shell of a bird's egg is very porous and fragile, but yet sufficiently hard and compact to resist the friction which it may receive from its fellows, or from close contact with the belly of the mother during incubation. Owing to its porous texture, it is permeable to the moisture which exudes from it, and to the air by which that moisture is replaced. It consists of 89 parts, in the hundred, of carbonate of lime, and of 5 of phosphate of lime, cemented by an animal gluten. Immediately under this shell is a thin, soft, transparent, compact membrane, which incloses, 1. a viscous, tenacious, and limpid fluid, constituting the albumen, or white; 2. a globular body, floating in the middle of this fluid, of a soft consistency, and yellow colour, termed the vitellus or yolk; and, 3. a minute white body, placed at a point of the membrane which surrounds the yolk, and denominated *cicatricule*, containing the germ, or embryo, in which resides that mysterious influence of nature, destined, under certain circumstances, to transform it into an organized and living being. The albumen is not a homogeneous substance, but is composed of three layers, the outermost of which is the most liquid, especially in the fresh state of the egg, the second is more abundant, and of more consistency than the first, and the third, which also possesses a certain degree of consistency, has the appearance of two insulated bodies, united by a very slender albuminous process, and, under the technical designation of *chalazæ*, serving to suspend the yolk. These bodies are not situated at the poles of the latter, but divide its circumference into two very unequal segments of a circle, so that the embryo, however the egg may be turned, retains its proper place, and receives more immediately the heat of incubation. Each of the portions of this last albuminous layer is traversed by a double spiral chord, one of which is membranous, and the other vascular, the first contiguous to the membrane of the yolk, and the second continuous with that pellicle, and identified with it, presents us with the point of communication between the yolk and the white, and by means of which the albumen is absorbed into the vitellus during incubation. On examining the yolk, we find that its form depends on the membrane which invests it; for, when this last is torn, the contents give way, in the state of a fluid, which has the consistency of very thick milk, and the appearance of a very strongly impregnated emulsion.

The eggs of birds have, generally, an elliptical form, more or less elongated according to the species, with a somewhat broad, and a more pointed end. In most cases, they present a predominant colour, on which are scattered spots, or blotches, more or less numerous: but some are of a uniform colour. During the progress of incubation, the spots seem both to increase in number, and to deepen in colour, though, in fact, they only become more visible to the eye; and they are, generally, larger, more concentrated, and more numerous, towards the broad than towards the narrow end. The eggs of diurnal birds of prey have usually a whitish ground, spotted with red, or red spotted with brown. Such as incline to red, are apt to lose their tint as they approach to the complete term of incubation. It has been remarked, that the white or whitish eggs of the swimming families are short and rounded, whereas the yellow, greenish, or spotted of the same tribes, are of a more prolonged form. Those of the waders are seldom spheroidal, but more commonly oblong, and taper rapidly from the broad end.

It is well deserving of notice, that, in consequence of the oviparous mode of procreation, the flight of the female is not impeded by the burden of a gravid uterus; and that all the brood are hatched together, though the eggs are excluded singly, and at considerable intervals, so that the female parent is not incumbered with the load of more than one full grown egg at a time.

A small quantity of moisture always evaporates from an egg; and its escape is generally indicated by a cavity in the white when boiled, and not quite recent. To counteract this evaporation, which deprives the albumen of part of its fluidity, the egg, when laid, should be rubbed over with some unctuous substance, or dipped in lime-water, in which state it may be preserved sound for years. If the artificial coating be carefully removed, the egg may even be hatched at the distance of nearly six weeks from the time that it was laid; and, thus, when birds cannot be conveniently transported alive, the eggs may be conveyed to any given place, and the young brought forth. This, however, is scarcely practicable, except in those cases in which the nascent bird is capable of walking, and of feeding itself.

There is reason to believe, that, besides the exhalation of a portion of its humidity, the egg, in order to be hatched, must, moreover, absorb a certain quantity of vital air from the atmosphere, which communicates to the albumen the property of concreting, so as to form different parts of the pullet. But, besides these requisites, an indispensable one is a certain degree of heat, which, with a few exceptions, is produced and sustained by the body of the female parent. Birds appear to be endowed with a capacity of regulating the temperature that is necessary for this purpose, so that, if the heat of the air, together with the natural warmth of the body, should be too great, the breeder leaves the eggs, for some time, to cool. In the early stages of incubation, she quits them more frequently than when the embryo is more perfect; yet, in the advanced state, the risk from such temporary dereliction is not greater, if so great; for a live chick has frequently been found in an egg that has been kept two days out of the nest. If the young, however, is within a few hours of exclusion, and the egg is then suffered to be some time cold, the new formed animal either dies, or becomes too weak to extricate itself from the shell. Birds frequently turn and change the position of their eggs, in order to heat all parts of them equally. It seems, also, to be ascertained, that various degrees of warmth will enlarge the embryo, but that a regular temperature is essential to its production, and yet, artificial heat, corresponding to that of a brooding bird, or about 96 of Farenheit's thermometer, will not produce young with the same constancy; for although, in Egypt, multitudes of eggs, as is well known, are hatched in stoves, it is supposed that a fourth, or even a third of the whole number, miscaries.

The term, and other particulars of incubation, vary in the different species; but its effects have been most frequently and most distinctly noted in the case of the common chicken, which will, therefore, form an interesting exemplification of this part of our subject. The hen has scarcely been twelve hours on the egg, when some lineaments of the head and body of the chick become apparent. The heart may be seen to beat at the end of the second day; and it has, at that time, somewhat the form of a horse-shoe, but without any visible appearance of blood. Two blood vesicles, however, may soon be distinguished, viz. one in the left ventricle, and the other at the root of the great artery, exhibiting distinct pulsations. At the 50th hour, one auricle of the heart, like a noose folded down on itself, becomes manifest. At the end of 70 hours, the wings are traceable; and, on the head, two minute vesicles are seen for the brain, one for the bill, and two others for the fore and hind part of the head. Towards the end of the fourth day, the two auricles, already visible, draw nearer to the heart than before. The liver appears towards the fifth day. In the course of 131 hours, the first voluntary motion is observed: at the end of seven hours more, the lungs and the stomach are discernible, and, in four additional hours, the intestines and the upper jaw. At the 144th hour, two ventricles are discoverable, and two drops of blood, instead of the single one which was seen before. On the seventh day the brain begins to have some consistency. At the 190th hour from the commencement of incubation, the bill opens, and the flesh appears on the breast. In four hours more, the breast-bone is seen; and in six hours after this, the ribs appear, proceeding from the back, while both the bill and the gall-bladder are obvious to the sight. Towards the 240th hour, the feathers begin to shoot out, and the skull becomes gristly. At the 264th hour, the eyes appear; and at the 288th, the ribs are perfect. At the 331st, the spleen is drawn near to the stomach, as the lungs are to the chest.[1] At the end of 355 hours, the bill frequently opens and shuts; and at the close of the 18th day, the chicken is first heard to cry. It afterwards acquires more strength, and continues to grow till about the 21st day, when it frees itself from its confinement, by means of a bony point on the bill, which cracks and splits the shell, and which drops off some days after birth. In the course of the wonderful process which we have just sketched, the commencement of ossification is not perceptible before the beginning of the 9th day, which corresponds to the 17th week of human pregnancy; but in the human embryo, the first points of ossification become visible in the 7th or 8th week. The celebrated Haller, therefore, has inaccurately asserted, that the facts relative to the formation of the bones of the incubated chick will hold good of those which respect the other classes of animals.

*Age, Diseases, &c.*—The term of life is very various among the different families and species of birds, and it seems to bear the same proportion to the time of acquiring their growth as has been remarked with regard to quadrupeds; for most of them attain to their full dimensions in a few months, and are capable of propagating the first summer after that in which they are hatched. Many of them run as soon as they are excluded from the shell, and are capable of flying at the end of four or five weeks. In proportion to the size of their body, however, birds possess more vitality, and live longer than either quadrupeds or man. Notwithstanding the difficulties which arise in attempting to investigate their age, many of them have afforded well attested instances of great longevity, particularly geese, swans, and eagles, which have been known to reach to seventy, fourscore years, or even a century. A gentleman in Coleraine had a parrot which was imported from Jamaica in 1699, and which was still alive in 1768, but its plumage had become quite grey. Pigeons usually live more than 20 years; and even linnets, and other small birds, have been kept in cages for nearly the same period. This comparative longevity of birds has been attributed to the texture of their bones, the hardness and solidity of which have been assigned as the general cause of death among other animals. Those of birds, being lighter and more porous, are supposed to present fewer obstacles to the vital functions; and nature, thus finding more room for the performance of these functions, carries them on to a more distant period. The diseases to which this class of animals is naturally liable are, probably, neither numerous nor formidable; at least we seldom meet with individuals which seem to labour under sickness or infirmity. In northern latitudes, indeed, they are sometimes subject to the pressure of cold or hunger; but the debility and other symptoms attendant on these external accidents, scarcely deserve to be noticed in a nosological point of view. We have already adverted to the crisis of moulting; and we may observe, that seclusion from the open air, and a change of habits, from domestication, frequently induce appropriate ailments, as pining, epilepsy, apthæ, pip, &c. and that they frequently aggravate some of those maladies to which they may be exposed in a wild state.

It is a well known fact, that dead birds are seldom found in the fields and woods. When reduced to weakness by indisposition or old age, they probably fall an easy prey to some of the rapacious tribes; or, if allowed to drag out their existence to the last in the more retired recesses of the forest, they may elude our more ordinary observation, and be speedily despatched by the feeders on carrion. At all events, the most elegant form, the most splendid colouring, and the most tuneful voice, cannot redeem one of them from the irretrievable doom of all terrestrial beings; but, whilst individuals daily perish, the race abides; and corruption and renovation are still the grand counterpoises of nature.

*Fossil Remains.*—If the bodies of dead birds are seldom to be met with in a recent state, we need not be surprised at the very rare occurrence of their fossil remains. The *hieracites*, *perdicites*, &c. of the ancients, were variously coloured or figured stones, which bore some accidental resemblance to the exterior appearance of birds. The petrified nests, eggs, &c. cited by Lesser, Gessner, Baccius, and others, were possibly either stones of the kind just mentioned, or mere incrustations, including the substances which had themselves undergone no change,—like specimens from Matlock, Knaresborough, and various other places, where the water deposits carbonate or phosphate of lime. The reputed birds' beaks of Jena and Weimar, noticed by Linnæus and Walleri-

Fossil Remains.

us, are, according to Walch, only deceptive resemblances. Dr Peter Camper and the Abbate Fortis both examined a supposed fossil bird, of which a figure is given in one of the numbers of the *Journal de Physique*, but neither of these observers would admit its genuineness. An engraving is also published in the same work for Thermidor, year 8, of a stone with the apparent impression of the two legs of a bird; but it has been stated that nobody in Paris had seen the original specimen. In the same publication, however, the foot of a bird, incrusted in the gypsum quarries of Clignancourt, near Montmartre, is figured and described by Cuvier, proving the existence of real ornitholites in the ancient beds of gypseous matter. Blumenbach mentions the discovery of the bones of a water-fowl in the marly schistus of Oeningen, and of a bone of one of the anseres in the calcareous schistus of Pappenheim. Faujas de Saint-Fond has also presented us, in the *Annales du Muséum*, with two indubitable and curious sketches of fossils belonging to this class of animals being the impressions of two *feathers* from the quarries of Vestena Nuova, imbedded in the same stone as the fishes of Monte Bolca. Part of a feather, inclosed in the fissile stone of Oeningen, is figured by Scheuer. Walch likewise describes two analogous specimens, in his own possession, namely, the barrel part of a quill, to which a remnant of the vane adheres, and a small feather, with its tubular portion. The bill described by Romé de Lisle, and figured in Davila's catalogue, is, in the opinion of Cuvier, merely a bivalve shell, fixed obliquely in the stone. In 1782, Lamanon described, in the *Journal de Physique*, an entire fossil bird from Montmartre; but he allowed his fancy rather too free a scope, since he added the wing-feathers and tail. Fortis, on the other hand, who scrutinized this specimen with his sceptical prepossessions, conceived it to be the remain either of a frog or a toad; but Cuvier, a more competent judge, confidently asserts that it has really belonged to a bird. From the Memoir on Ornitholites, composed by that celebrated comparative anatomist, it results, that not more than five examples of the fossil remains of birds had been unequivocally ascertained prior to his own interesting researches, and that seven additional instances have been detected in the plaster-quarries near Paris, that fruitful source of geological discovery and conjecture. The first consists of the shoulder-blade and thigh-bone of a species of pelican; the second is an inferior articulation of the femur of an ibis; the third, the humerus of a species allied to the woodcock; the fourth, one of the most entire, also a humerus, and nearly related to that of the starling; the fifth, a foot and wing-bone, apparently of the sea-lark; the sixth, a pretty entire skeleton, which may be referred to a large species of quail; and the seventh, four articulations of the middle toe of a bird of considerable dimensions. The only well authenticated example of petrified eggs is that of six, which seem to have belonged to the partridge, and which was found in a crystallized state, in disrupted soil, at Terruel, in Arragon, by workmen who were employed to dig for the foundation of a bridge. They are described by de la Méthérie in the 53d vol. of the *Journal de Physique*; and the nature of the territory in which they occurred is particularised in the same volume by Prof. Proust. Along with the numerous bones of quadrupeds in Kirkdale cavern, in the oolitic limestone of Yorkshire, were found a few belonging to birds. One in particular, figured in the Geological Survey of Yorkshire, is supposed to be the wing-bone of a goose, or large duck; and Professor Buckland obtained from the same repository wing-bones of a raven and of a large pigeon, distinctly characterized. We have been thus minute in our indications of the fossil remains of birds because they are of such rare occurrence. We may add, that they are more imperfectly preserved than the relics of other animals, being frequently much compressed or shattered by dislocation of the soil.

Uses of birds.

*Uses of birds.*—If we next attend for a moment to the uses of birds, we shall find that the rapacious sorts contribute to preserve the salubrity of the air, by devouring carrion, which would otherwise diffuse the most putrid and noxious exhalations. The waders co-operate in this purifying process, besides that they destroy toads, lizards, serpents, &c. which would, if unchecked, multiply with alarming rapidity. Hence, the inhabitants of Egypt and of Holland acknowledge their obligations to the stork. In the former country, in particular, which abounds with noisome reptiles, this favourite bird is protected, even in its wild state, by the sanction of the laws. The granivorous birds are also deemed of great utility in the system of nature, inasmuch as they limit the profusion of those weeds, which would, if unrestrained, soon overspread the earth, and infallibly predominate over the more useful vegetables. Many species of the present class, moreover, contribute to the transmission of seeds from one country to another, and thus to scatter some valuable plants more universally over the globe.

In regard to their more immediate connection with the interests of man, it deserves to be remarked, that of their countless myriads which inhabit the air and the water, not a single species is known to be of a poisonous nature; for, although they differ, indeed, in being more or less salutary and palatable articles of diet, none of them are directly pernicious; neither have the eggs of any of them been found to possess noxious qualities, a circumstance well known to sea-faring people and travellers, who, unhesitatingly, partake of them without inconvenience. If the granivorous families occasionally levy contributions on our crops, they also rid us of hosts of insects and their larvæ, which, if permitted to multiply unrepressed, would blight or annihilate the hopes of the husbandman. Carnivorous birds, though not deleterious, are generally avoided as food, as are the piscivorous sorts, especially those with sharp bills, although the young of some of them are eaten with relish. It has been noticed, as matter of surprise, that so few birds have been rendered subservient to economical purposes, by domestication; but most of them are naturally shy and timid, and appear to be but little susceptible of familiarity and obedience. Jealous of their liberty, and furnished with the means of evasion, they shun the haunts of mankind, and prefer to abide in the primitive wilder-

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nesses of nature. Of the rapacious order, not one species has been reclaimed, except for the purposes of falconry, when they are taken young from the nests of the wild ones. None of the *picæ* have been reduced to a permanently domestic state; but several of the gallinaceous families, and particularly the common fowl, have been advantageously adopted into the poultry-yard. Of the columbine and kindred tribes, the pigeons only have been tamed. Of 4000 species, in short, enumerated and characterized by Latham, not more than 10 or 12 have been brought within the stated range of household economy.

The plumage of many species of birds ministers to the warmth, the repose, and to the real or fancied decoration, both of the civilized and of the untutored portions of our race, whilst we naturally associate the quill with the finest efforts of genius and of learning, and with that multiplied interchange of ideas and sentiments which promises to humanize and exalt the nations of the earth.

## CHAP. II. CLASSIFICATION.

The limits assigned to this article necessarily preclude every attempt at a detailed and consecutive exposition of the families and species of birds—a circumstance which we the less regret, because, from the days of Aristotle to those of our most recent ornithologists, no systematic arrangement of the class has appeared that is not liable to many and weighty objections. As that, however, lately proposed by Mons. Temminck, in the second edition of his *Manuel d'Ornithologie*, though, in various respects, open to criticism, is, perhaps, on the whole, the least exceptionable, we shall be contented to state the leading characters of his orders, with the exception of the 16th, which is of doubtful institution, and to exemplify each by a short account of one of its most prominent species.

### ORDER I. RAPACIOUS BIRDS.

Bill short and strong, the upper mandible recurved at its base—compressed on the sides, and bent towards the extremity. Nostrils open; legs strong, nervous, short, or of moderate length, and feathered to the knee, or even to the toes. The latter consist of three before, and one behind, articulated on the same plane, either entirely separated, or united by a membrane at the base; they are rough on the under surface, and armed with powerful, sharp-pointed, retractile, and bent claws.

The birds of this order mostly subsist on the living or dead flesh of mammiferous animals, birds, fishes, and reptiles; but a few of the smaller species attack only insects, particularly those of the coleopterous families. Hairs, feathers, or other indigestible matters, which they swallow along with their prey, they again throw up, in the form of balls, or pellets. The females are of larger dimensions than the males, sometimes even in the proportion of one-third. Though voracious when food is within their reach, they are capable of enduring protracted abstinence. In most cases, they dispense with water. The diurnal kinds have very strong and powerful vision, take long and lofty flights, and, from a great elevation, pounce down on their victims with rapidity and accuracy. They are of unsociable habits, pairing in solitude, nestling on sequestered or inaccessible cliffs, or the tallest trees; and the female seldom lays more than four eggs, though the number varies from one to seven.

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*Cathartes gryphus*, *Vultur gryphus*, Lin. &c. *Condor*, *Cundur*, or *Great Vulture of the Andes*. A dark spot on the wings—ruff white. The male has a large caruncle above, and another under the beak; but the female is destitute of both. Gmelin and Molina, however, are mistaken when they assert that the female, moreover, wants the ruff of long white feathers round the lower part of the neck. During some months, the young are covered only with a fine down, or white frizzled hair, which gives them a large and turgid appearance. At the age of two years, their plumage is not black, but fawn brown, whence the common but erroneous notion of two distinct species of condor, called the *black* and *brown*. The general plumage of the adult is sometimes glossy black, and sometimes black verging on greyish. The total length of the body is from two to three feet, and the extent of the outstretched wings from eight to ten feet. Much more ample dimensions have been stated by various travellers and naturalists; but Humboldt, in part, accounts for their exaggerations; for, as the bird is most frequently observed seated on a cliff, just beneath the lowest limit of perpetual snow, it appears, by an optical deception, considerably to exceed the terms of actual measurement. It is still more remarkable for the enormous strength of its bill, wings, and claws, than for its size, pouncing down on its prey with mortal energy, and being capable of carrying off lambs, and attacking the llama and guanaco. Two of them will unite to hunt deer, the puma, or even a heifer. The latter they harass with such perseverance, wounding it with their talons and bill, that, almost breathless and exhausted with fatigue, it thrusts out its tongue with a groan: The condors seize on this protruded member, of which they are very fond, and tear out the eyes of their victim, which gradually expires, and affords them an ample repast. When glutted with food, they are sedate and indolent; but when they soar aloft, they often vanish from the sight of the spectator, and above the ordinary region of the clouds which hover over our plains. On these occasions, they are prompted by the calls of hunger to embrace, at one glance, a wide extent of country, and select the object of their attack. Though they occasionally descend into the low plains for food, their favourite abode is among the cliffs of the rocks, at 9000 or 10,000 feet above the level of the sea, on the great chain of the Andes, courting the solitude of the mountains, and breathing a very rarified air. Humboldt was assured, that the female makes no nest, but deposits her eggs, which are quite white, and two or three inches long, on the bare rock. It is also alleged, that the young continue with the mother during a whole year.

These formidable birds are frequently caught alive, in Peru, Quito, and Popayan, by nooses

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thrown over them, when glutted with the carcase of a horse or cow, purposely placed within their reach; for they are then too heavy for flight, unless they disgorge the accumulated contents of their stomach, as they sometimes do, and thus escape the snare. At other times, deleterious herbs are introduced into the animal that is exposed as a lure, and which stupify the unconscious invader.

It has been generally supposed, that the accounts of this species gave rise to the hyperbolical description of the *roc*, which makes so conspicuous a figure in the Arabian Nights Entertainments. But it does not appear that the condor has ever been met with in the old continent; and the traditions concerning the roc might, possibly, originate in the *laemmer geyer* of the Alps, a variety of the bearded eagle, which is occasionally seen among the mountains of the east.

### Order II. Omnivorous Birds.

Bill of moderate size, strong, sharp-edged, with the upper mandible more or less notched at the point. Feet with four toes, namely, three before, and one behind. Wings of moderate dimensions, with the quill-feathers terminating in a point.

The birds which compose this order live in groups. One female suffices for a male. They nestle in trees, in the holes of ruined walls, and old towers, &c. The female and the male generally incubate alternately. They live on insects, worms, and offals, as well as on grains and fruit. Their flesh is, for the most part, hard, tough, and unsavoury.

*Paradisea major*, Shaw, *P. apoda*, Lin., &c. *Greater Bird of Paradise.*—Body of a cinnamon hue, crown luteous, throat golden-green, or yellow, side feathers very long and floating. Length, from the point of the bill to the end of the tail, about one foot; but, if measured from the tip of the bill to the termination of the elongated feathers, nearly two feet. Some of the long-flowing feathers are of a dirty white, others yellow, some, especially the shortest, are spotted with red, and several with vinous red extremities take their origin from the sides of the body under the wings, and extend much beyond the tail feathers; the two long filamentous feathers which issue from above the rump, and stretch far beyond the tail, are brown, downy at their commencement, and then exhibit very short and stiff beards, which lengthen towards the extremity, where they form, as it were, a narrow palette. The bill, feet, and claws, are greenish-yellow. The Indians allege that the female is chiefly distinguished from the male by her smaller size; and Levaillant assures us, that she wants both the flowing plumes and the filamentous appendages which we have just described.

This species remains in the Azores islands during the dry or western monsoon, and returns to New Guinea at the commencement of the rainy or eastern monsoon. Its migrations are effected in bands of thirty or forty, under the guidance of another bird, which, according to Valentyne, is black spotted with red, which always flies above the flock, and which the inhabitants denominate *king*. Each band keep close by their chief, whether in motion or at rest; but this devoted attachment to their leader sometimes proves fatal to them; for, as he reposes on the ground, and they rise from it with great difficulty, on account of their form or the peculiar disposition of their feathers, they are readily caught or dispatched. They naturally perch on lofty trees, particularly on the *ficus benjamina* of Forster, the red fruit of which they eat. During the eastern monsoon they lose their gaudy and waving plumage, which is replaced in the course of four months. By means of its quantity, extent, and pliancy, they are enabled to ascend to great heights, to support themselves in the air, and to traverse it with the rapidity of a swallow. But as they cannot fly in the direction of the wind, without having their lax system of feathers quite ruffled and discomposed, they purposely avoid this embarrassment by mounting higher in the atmosphere, and falling in with another current of air, so as to continue their rout without inconvenience. Although, however, they always steer their course in opposition to the wind, they are occasionally overtaken by violent squalls, against which they vainly struggle, until quite baffled and exhausted they drop down on the ground. The natives, attracted by their clamour, run to the spot and quickly deprive them of life. On other occasions, they are caught by bird-lime, or springes, or shot with blunted arrows, or intoxicated, and rendered stupid, by poisoning their drinking stations with *menispermum cocculus*. When taken alive, they defend themselves with courage, and inflict severe blows with their bill. During their flight, they cry like starlings; but, when a storm blows in their rear, they utter a note somewhat resembling the croaking of a raven. In calm weather, great numbers of these birds may be seen flying, both in companies and singly, in pursuit of the larger butterflies and other insects on which they feed.

The Papuans no sooner kill one of these birds, than they remove the feet, viscera, and breast-bone, pass a red iron through the body, dry it in smoke or the vapours of sulphur, replace the iron by a piece of stick, and pack the whole in a hollow bamboo. Others are contented merely to strip off the feathers. The prepared and mutilated specimens are mostly conveyed to Banda, where they are sold at the rate of half a rix-dollar each, and whence they are exported to various districts of India and Persia, as ornaments to the turbans of persons of rank, and to the trappings of horses. Not long ago, they were used for decorating the head-dresses of our British fair.

Pigafetta having had ocular demonstration of the existence of the legs in this species, and of the natives cutting them off previously to selling them, recorded the facts in his journal; but so rooted was the contrary notion in Europe, that Aldrovandus charged him with an audacious falsehood; and the sagacious Scaliger still adopted the popular persuasion. It was, moreover, supposed, that the greater paradise bird, like others of its genus, perpetually floated in the atmosphere, or suspended itself, for a short time, by the naked shafts; that it never descended to the earth till its last hour; and that all which had been procured, had dropped from their aerial elevation during the moments immediately preceding their fate.

### Order III. Insectivorous Birds.

Bill middle-sized, or short, straight, rounded, faintly sharp-edged, or subulate, with the upper mandible curved and notched at the point, most frequently furnished with some rough hairs at the base: Feet with three toes before and one behind, articulated on the same plane, the outer consolidated to the base, or even united to the first articulation of the middle toe.

The voice of the birds of this division, is characterised by its harmony and cadence. Most of them subsist chiefly on insects, especially during the breeding season; but many of them have likewise recourse to berries. They have often more than one brood in the year. They inhabit the woods, bushes, and reeds, in which they form solitary nests.

*Sylvia luscinia*, Lath. Tem., &c. *Motacilla luscinia*, Lin. *Nightingale* or *Nightingale Warbler.*—Rusty brown, tinged with olive above, pale cinereous beneath, and almost white on the throat and belly. Length, about six inches; but both the male and female are liable to vary in size, without, however, exhibiting any undue disproportion between one another in this respect. Among the varieties noticed by ornithologists, one entirely white has been particularised; but this is an accidental and morbid state of the bird, analogous to albinoism in the human species. The name of *nightingale* has been likewise vaguely and improperly applied to different species of birds remarkable for their tuneful notes. That now under consideration is limited to the old continent, betraying local and apparently capricious preferences, ranging, for example, over Europe, from Spain and Italy to Sweden, yet a stranger to Scotland, to a large portion of the north of England, and to Ireland. In England, it seems not to have advanced further north than Yorkshire, nor further west than the eastern borders of Devonshire, whereas it is plentiful both in Somersetshire and Dorsetshire. Again, though unknown in Lincolnshire, it has been heard on the confines of that county, near Peterborough. From a large district of Bugey in France, from most of Holland, &c, it is an alien. It occurs in Siberia, Kamtschatca, China, and Japan. In Europe it is migratory, arriving in spring and departing in autumn, to winter in Africa and Asia Minor.

These birds have a sort of vibratory motion, alternately raising and depressing their body, and oscillating the tail upwards and downwards. As the ancients believed that they passed the night in singing, so they alleged that they never slept, that their flesh had a soporific quality, but that the heart and eyes, laid under a person's head, would keep him awake. On these erroneous surmises, the nightingale became an emblem of vigilance; but the moderns have ascertained, that, in the breeding season, it sleeps in the day, and even dreams.

On their first arrival in the provinces of Europe, these birds affect the bottoms of hedges and inclosures, which are calculated to afford them at once concealment, protection from the cold, and insect food; but, as soon as the forests put forth their verdure, they retire into the thickest recesses, and take up their abode under the covert of a hill, or in the neighbourhood of a brook, or of an echo, with which they seem to be pleased. The male selects two or three favourite trees, from which he pours forth his song. When once paired, he allows none of his fellows to intrude on his chosen domain; but fierce contests sometimes ensue for the possession of the females, which arrive about ten days later than the males. The nest is loosely composed of quantities of coarse grass and dried leaves of the oak, and lined with hair, fibrous roots, or other soft materials. It is usually placed near the ground, in the middle of a bush, at the foot of a hedge, or of a row of hornbeams, or on the under branches of some tufted shrub. The hatch generally consists of from four to six eggs of an olivaceous green, which frequently fall a sacrifice to dogs, polecats, weasels, &c. The female, though a close and ardent sitter, is sometimes relieved by the male, who also bears his share in the construction of the nest. From the moment that the young are hatched, both parents attend them with much assiduity, fetching food for them in their bill, or even disgorging what they had previously swallowed, if they bring it from any distance. The nascent birds acquire their feathers in about a fortnight; and they quit the nest even before they can fly, hopping from twig to twig after their parent. Towards the end of August, or sooner, if their stock of provisions begin to fail, both old and young resort to the hedges, orchards, freshly turned up fields, &c. where they find more abundant fare, and add to their ordinary diet elder-berries and other fruits, on which they fatten. In some countries they are then snared, and reckoned as dainty as ortolans.

The nightingale is reputed to excel all birds in the softness and mellowness, as well as in the duration of its warble. Though heard to most advantage in the stillness of a fine evening, it also sings in the daytime, but, as its tones are then blended with those of the other choristers of the grove, they are neither so readily distinguished, nor so pre-eminently admired. In its natural state, it usually ceases to be tuneful in June; but in confinement it will sing for nine or ten months together. Besides, a caged individual of this species sings much more sweetly than those which we hear abroad in the spring. The latter are, as the bird-fanciers term it, so *rank*, that they seldom sing any thing but short and loud jerks, which, consequently, cannot be compared with the notes of a caged bird, since the instrument is thus overstrained. Mr John Hunter ascertained, by dissections, that the muscles of the larynx of the nightingale are stronger than those of other birds of the same size. The Hon. Daines Barrington, who kept a very fine specimen for three years, and who bestowed particular attention on its musical faculties and exertions, had occasion to observe, that the sound of its song filled the circle of an English mile in diameter, which is equal to the power of the human voice. When it *sang round*, in its entire compass, he remarked sixteen different beginnings and closes, at the same time that the intermediate notes were varied in their succession with so much judgment as to produce the most pleasing effect. It would sometimes continue its warble for twenty seconds without a pause, and whenever respiration became necessary, it was taken as skilfully as by an opera singer. The same gentleman and Kircher both attempted to reduce the strains of the nightingale to technical form; but the musical intervals elude notation, and the measures are so varied, the transitions so insensibly blended, and the succession of tones so wild and irregular, as to defy our methodical fetters. These birds, however, differ very much in regard to the quality of their song, for in some it is found to be so indifferent that they are not reckoned worth keeping. Yet the musical property of the male is, generally speaking, very decided, as might be illustrated by various entertaining anecdotes, if we could make room for them. We have also to observe, that the nightingale may be domesticated, though not without considerable pains and difficulty, that it is susceptible of personal attachment, of acquiring musical lessons, and even of articulating words. But we are not prepared to assert, with Pliny, that it may be drilled to spout Greek and Latin orations, nor with Gessner, that it may be trained to converse on the politics of Europe.

### ORDER IV. GRANIVOROUS BIRDS.

Bill strong, short, thick, and more or less conical; the mandibles most frequently without a notch. Feet, with three toes before and one behind, and the anterior divided. Wings of moderate size.

The species ranged under this denomination live in pairs, and are migratory or sedentary, according to the nature of the climates in which they breed; but most of them pass and repass to and from their summer and winter abodes at stated periods, and assemble in large flocks previously to commencing their appointed flights. They feed principally on grains and seeds, from which many of them detach the husk, but they have frequently recourse to insects, especially for their young. They may be maintained in confinement on grain alone. Next to pigeons and poultry, they are most susceptible of the approach and discipline of mankind. Most of the foreign species moult twice a-year. The males are gaily or splendidly attired in the season of courtship, but in winter they assume the sober livery of the females.

*Ploccus Socius*, Cuv. *Loxia Socia*, Lin. Lath. &c. *Sociable Weaver*, *Sociable Gross-beak*, or *Republican*. Reddish-brown above, yellowish beneath, capistrum black, tail short. About the size of a bull-finch. Inhabits the interior parts of the Cape of Good Hope and India, in sheltered and sequestered situations, behind hills. They live in large societies, and in perfect harmony with one another, and build their nests or dwellings on a species of *Mimosa*, which grows to an uncommon size, and which, from its ample head, and strong and wide-spreading branches, is well calculated to admit and to support their curiously fashioned lodgings, while the tallness and smoothness of its trunk are alike unfriendly to the invasions of the reptile and monkey-tribes. The acacia trees, and the *aloe dichocornes*, are selected by this gregarious species for the same purpose. Notwithstanding all their precautions, however, their social union is sometimes disturbed by a small kind of parrot, which assaults and takes possession of their nests. In one tree, described by Mr Paterson, who first made us acquainted with the sociable weaver, there could not be fewer than from eight hundred to a thousand nests under one general roof. Mr Paterson calls it a *roof*, because it resembles that of a thatched house, and projects over the entrance below in a very singular manner. ‘ The industry of these birds," observes this traveller, " seems almost to equal that of the bee. Throughout the day they seem to be busily employed in carrying a fine species of grass, which is the principal material they use for the purpose of erecting this extraordinary work, as well as for additions or repairs. Though my short stay in the country was not sufficient to satisfy me by ocular proof that they added to their nest as they annually increased in numbers, still, from the many trees which I have seen borne down by the weight, and others which I have observed with their boughs completely covered over, it would appear that this is really the case. When the tree, which is the support of this aerial city, is obliged to give way to the increase of weight, it is obvious that they are no longer protected, and are under the necessity of building in other trees. One of these deserted nests I had the curiosity to break down, to inform myself of the internal structure of it, and found it equally ingenious with that of the external. There are many entrances, each of which forms a regular street, with nests on both sides, at about two inches distance from each other. The grass with which they build is called the *Boshman's* grass, and I believe the seed of it to be their principal food, though, on examining their nests, I found the wings and legs of different insects. From every appearance, the nest which I dissected, had been inhabited for many years; and some parts of it were much more complete than others. This, therefore, I conceive to amount nearly to a proof that the animals added to it at different times, as they found necessary from the increase of the family, or rather of the nation or community."

### ORDER V. ZYGODACTYLOUS BIRDS.

Bill of various forms, more or less curved, or much hooked, but also frequently straight and angular. Feet uniformly furnished with two toes before and two behind, of which the outer hinder one is often capable of being turned forward. This disposition of the toes is, in some species, subservient to the purposes of climbing, and in others to those of prehension.

Most of the European families belonging to this order chiefly subsist on worms, and the larvæ of insects, particularly caterpillars; but others which inhabit the remaining quarters of the world, have their bills adapted also to feeding on soft fruits or kernels. The greater number of them nestle in the hollows of trees.

*Psittacus Amazonius*, Shaw; *P. Æstivus*, Lin. &c. *Amazon Parrot*, *Common green parrot*, &c.—Green, with the edges of the shoulders red, a red patch on the wings, the crown of the head yellow, and the frontal bar blue. The varieties, which are very numerous, have given rise to a voluminous catalogue of names, and, in some cases, to a superfluous multiplication of species. These birds are natives of South America, especially of that extensive territory which is watered by the river of the Amazons. They live in numerous societies, which never entirely separate; and they are very clamorous, except when they attack orchards and plantations. They breed in the midst of dense forests, the female laying three or four white eggs in the hollow of a tree. The young are at first quite naked, and then covered with a whitish-grey down, which is gradually succeeded by the plumage. On issuing from the nest, the males and females resemble one another.

The wonderful parrot, which held a conversation with Prince Maurice, as recorded by Sir William Temple and Mr Locke, appears to have belonged to this species, as did that which Col. O'Kelly purchased at Bristol for a hundred guineas, and for the use of which he was offered L.500 a-year, by an exhibitioner of curiosities. It not only repeated a great number of sentences, but answered many questions, and could whistle a considerable variety of tunes; and so accurate was its judgment, that if by chance it missed a note, it would revert to the bar where the mistake was made, correct itself, and, still beating regular time, go through the whole with wonderful exactness. It could express its wants accurately, and give orders somewhat like a human being. Its age was not precisely known; but it lived more than thirty years in Col. O'Kelly's possession, and its death, which occurred in 1802, was formally announced in some of the public prints. It was dissected by Dr Kennedy and Mr Brookes; and the muscles of the larynx were found to be remarkably strong.

In the year 1786, Signor Passeri of Rome bought, at Marseilles, a female of this species, and was, some months afterwards, presented at Avignon with a male. He put them together, and allowed them to walk about in the room at their ease. They often rested on the common perch; but sometimes they retired during the night to a large iron cage which was never shut, and, in all other places where they afterwards were, they enjoyed the fullest liberty. From the first moment that they met, they manifested a very striking mutual attachment, so that, if separated only for a few minutes, they betrayed the greatest agitation, uttering piercing cries, and never becoming quiet till they were put together again. When Mr Passeri first became possessed of them, they had attained their full growth; but he was unable to determine their age. The male distinctly pronounced several French words, and continued to do so; but the female made only a shrill cry, and prated a good deal, without articulating a single word. They accompanied their master to different parts of Italy, separately confined in a small wooden box. The female laid eggs several times, and made some abortive attempts at incubation. At last, in the month of June, she deposited two eggs in an earthen vase, half filled with cinders, which was on the ground, just within a door that concealed her while sitting. She sat forty days, and, on the 15th of July, an egg was hatched, but the young one died the next day. The fifth time that the female produced, she laid three eggs in the same vessel, or *scaldino*, filled with ashes, and standing in the doorway, as the year before. The incubation again continued forty days, and, on the 24th of June, a young bird came forth. Some days afterwards, the other eggs were thrown away as unproductive. The nascent parrot remained almost naked the first fifteen days; but afterwards the small grey quills of the wings began to shew themselves, and, by the 20th of August, the bird was completely clothed. It was the 14th of July before it began to open its eyes; and when it was well furnished with plumage, the mother, which had constantly slept in the nest, forsook it, and returned to the male. The following fact deserves particular attention: Mr Passeri, observing the growth of the young parrot, and fearing lest the scaldino should be too small to hold the mother and her young one, took a basket lined with feathers, &c., and put it in the place of the vessel behind the door. The mother seated herself in it immediately, and appeared to be very well satisfied with the new habitation; but some hours after she began to cut away one side of the basket with her bill, and in three days accomplished her task, having made an opening of four or five inches in the lower part, and six or seven in the upper. The osier was cut as neatly as if the sharpest knife had been employed. There can be no doubt that the mother's object was to facilitate the departure of the young bird from the basket, when it had acquired the requisite strength in its legs; thus regulating her parental conduct by the impulse of existing circumstances.

### ORDER VI. ANISODACTYLOUS BIRDS.

Bill more or less arched, often straight, but always subulate, filiform, and slender; feet with three toes before and one behind; the outer united at the base to that in the middle; the hinder one generally long, and provided with pretty long and hooked claws.

The birds of this division partake more or less of the habits and manners of those of the preceding order, many of them climbing trunks and branches of trees, or the face of vertical rocks, or clinging to such objects. Most of them are insectivorous, darting their extensile and filamentous tongue into the crevices of rocks, the fissures of trees, &c. in quest of their favourite prey. Others employ the same organ, in its tubular form, to extract the honied juice or nectar of flowers.

*Trochilus minimus*, Lin., &c. *Least Humming-bird.* Gold-green above; whitish beneath; wings and tail violet brown. Bill of the male black; feet brown; the middle tail feather bluish black, and the lateral ones grey tipt with white; about an inch and a half in length, and weighs only twenty grains. The female is even a little smaller, and has the upper parts of the body of a brownish green, with some metallic reflexions on the wing coverts, and the under parts of a dirty grey; native of Guiana and the West Indies. It is the most diminutive of known birds. The nest is described as comparatively large, owing to its thickness. It is covered outwardly with lichens, and lined with fine cotton, or other vegetable down. The eggs are of a dull white, and not larger than coriander seeds.

### ORDER VII. ALCYONIAN BIRDS.

Bill middle-sized or long, pointed, almost quadrangular, and either slightly arched or straight; tarsus very short; three toes before, united, one behind.

The species which belong to this recently instituted order have some analogy to the swallow tribes; for, like them, their flight is prompt and rapid. They neither walk nor climb, and they seize their food on wing, and frequently on the surface of the water. They rarely alight on the ground, nestle in holes excavated along the banks of rivers, and moult only once in the year. The males and females, and the young of a year old, present few differences in respect of colouring. The families are very limited in number, and inhabit the warmer regions of the old continent.

*Alcedo Ispida, Common* or *European King-fisher.*—Wing-coverts dark green, fulvous beneath, with the back of a brilliant blue, and the crown of the head green, marked with transverse blue spots. The tail is of a deep blue, and the other parts of the body are darkish orange, white, and black; so that, on the whole, it is one of the most elegantly coloured birds of Europe. It occurs likewise in Siberia, China, Egypt, at the Cape of Good Hope, &c. It weighs about an ounce and a quarter, and measures seven inches in length, and eleven in expanse of wing. The bill is nearly two inches long, and apparently disproportioned to the size of the head and of the other parts of the body, but perfectly suited to the habits of the bird. In its manners it is shy, solitary, and wary, frequenting the banks of streams and sea-shores, where it will sit for hours together on a projecting twig or a stone, now fluttering its wings, and exposing its brilliant plumage to the sun, and then hovering in the air, like the kestril, watching for the moment when it may dart on its victim, by dropping down on it perpendicularly. It will sometimes remain for several seconds under water, and then bring up the little fish, which it carries to the land, beats to death, and swallows. When it takes to flight, it spins its course in a direct line forwards, and with such rapidity that the motion of its wings is scarcely discernible; but it will occasionally stop short in its fleet career, remaining suspended, as it were, at each pause; and when it would change its place, it descends, and skims along the surface of the water, and then rises and halts again. This repeated and long-continued exercise evinces the uncommon strength of the muscles of its wings. When it falls on its prey it utters a shrill scream; but in spring it has another note, which may be heard through the murmuring of the stream or the dashing of the water-fall. The sexes, which keep separate, except during the breeding season, pair early in spring, when they usually take possession of a hole in the bank of a river or running stream, which had been excavated by a water-rat, mole, sand-martin, or land-crab, and which they enlarge or contract, or otherwise accommodate to their purpose. Dr Heysham had a female brought alive to him at Carlisle, by a boy, who said that he had taken it the preceding night when sitting on its eggs. Having often observed these birds frequenting the bank of the Peteril, he had watched them carefully, and at last he saw them go into a small hole, which was too narrow to admit his hand; but, as it was made in soft mould, he easily enlarged it. It was upwards of half a yard long, and at the end of it six eggs were placed on the bare mould, without the smallest appearance of a nest. They were considerably larger than those of the yellow hammer, and of a transparent white. It appears from a still more recent account, that the direction of the hole is always upward; that it is enlarged at the end, where it is furnished with a kind of bedding formed of the bones of small fish and some other substances, evidently the castings of the parents. This layer is generally about half an inch thick, and mixed with earth. There is reason to believe that both male and female come to this spot to eject the refuse of their food for some time before the latter begins to lay, and that they dry it by the heat of their bodies, as they are frequently known to continue in the hole for hours, long before the period of laying; and they are in the habit of discharging the indigestible portions of their food by the bill, like birds of prey. On this disgorged matter the female deposits and hatches her eggs. When the young ones are nearly full feathered they are extremely voracious; and as the old ones do not supply them with all the food which they are capable of devouring, they are continually chirping, and may be discovered by their noise. This species is of rare occurrence in Britain, and even in France; such of them as do not migrate are occasionally overtaken by the cold of winter, and found dead. M. Daubenton was enabled to keep several of them alive for a considerable length of time, by supplying them with small fish which he put into basins of water; but they refused all other kinds of nourishment Confinement does not render them tame; and their flesh is far from savoury, being impregnated with a disagreeable musky odour.

The kingfisher is the *Halcyon* of the ancient poets, who placed it on a floating nest, and endowed it with power to calm the adverse winds and waves. Nay, Aristotle and Pliny gravely relate, that it sat only a few days in the depth of winter, when the mariner might prosecute his voyage in full security; and hence the *halcyon days*, an expression which has descended to our own times. The ancients, moreover, believed that it rendered the fisherman's labours prosperous, dispelled lightning, imparted personal grace and beauty to individuals, and diffused peace and harmony among families. Even at the present day, the Tartars and Ostiacs apply the feathers of this bird to many superstitious uses. The former pluck them, cast them into water, and carefully preserve such as float; and they pretend, that if, with one of them, they touch a woman, or even her clothes, she must fall in love with them. The Ostiacs inclose the skin, the bill, and the claws, in a purse; and, as long as they preserve this sort of amulet, they believe that they have nothing to fear.

Chelidonian Birds.

An idea long prevailed in the most enlightened portions of Europe, that if the body of a kingfisher was suspended by a thread, the breast always pointed to the north. The flesh, too, was believed to be incorruptible, and to guard wardrobes and the stores of the woollen draper from the depredations of moths.

### ORDER VIII. CHELIDONIAN BIRDS.

Bill very short, much depressed, and very wide at the base; the upper mandible curved at the point. Legs short; three toes before, either entirely divided, or connected at the base by a short membrane, the hinder often reversible; the claws much hooked; wings long.

The flight of these birds is rapid and abrupt, their sight piercing, neck short, throat wide, and their broad bill often gaping for the reception of insects, which constitute their food.

*Hirundo Pelasgia*, Lin. &c. *Aculeated swallow* of Pennant, Latham, and Stephens, *American swallow* of Catesby, and *Chimney swallow* of Wilson. Dusky above, grey-brown beneath, tail feathers equal, having their tips naked, and armed with an awl-shaped point. Total length, four inches three lines. This species arrives in Pennsylvania late in April, or early in May, and builds its nest in high chimneys that are seldom used; but, in the districts inhabited by Indians, where such accommodation is wanting, it constructs it in hollow trees. The nest is in the form of the third part of a circle, and is composed of very small twigs, fastened together by a strongly adhesive gummy substance, which is said to be secreted from two glands, situated on each side of the hinder part of the head, and to be mixed with the saliva, but which, Vieillot asserts, proceeds from the *liquidamber styricifolia*, and which becomes as hard as the twigs themselves. With this material, the nest, which is small and shallow, is thickly covered. It is attached by one side, or edge, to the wall, and is destitute of the soft lining with which those of the other swallows are so plentifully supplied. The eggs are usually four or five, large in proportion to the size of the bird, oblong, and spotted and striped with black and grey-brown, towards the larger end, on a ground of pure white. The young are fed at intervals, even during the night. It frequently happens, in consequence of heavy rains, that the nest is detached from the sides of the chimney, and precipitated to the bottom, in which case the eggs are destroyed; but should there be young, they will scramble to the upper part, by clinging to the wall with their strong muscular feet, and, in this situation, continue to be fed by the old ones, for a week or more. There are two broods in the year. This bird is readily distinguished from the other swallows by the peculiarity of its flight, frequently shooting in various directions without any apparent motion of its wings. In roosting, the thorny extremities of its tail are thrown out for its support. It never alights but in hollow trees or chimneys, and seems to be always most gay and active during wet and gloomy weather. It is also the earliest abroad in the morning, and the latest out in the evening of any of the North American *hirundines*. In the first or second week of September, it leaves Pennsylvania for the south.

Columbine Birds.

### ORDER IX. COLUMBINE BIRDS, OR PIGEONS.

Bill of moderate dimensions, compressed, base of the upper mandible covered with a soft skin, in which the nostrils are perforated, the tip more or less curved. Feet, with three toes in front, quite divided, and one behind.

The Columbine families, by the gentleness and docility of their manners, are nearly allied to the gallinaceous fowls. Their food, which consists of grains and seeds, and more rarely of fruits, undergoes a sort of maceration in the crop, previously to being conveyed into the stomach; and it is in this macerated state that it is disgorged into the bill of the young one. The latter does not quit the nest till perfectly fledged. All pigeons drink at a single draught, by plunging their bill into the fluid. In their courtships, they coo and caress. In some countries they are migratory, and in others stationary.

*Columba migratoria*, Lin. &c. *Passenger pigeon*, *Migratory pigeon*, or *Canada turtle*. Tail cinereous, neck green-golden-purple, wings with ovate spots in the middle, breast rufous, and abdomen white. Length, from fourteen to fifteen inches; about the size of our common pigeon, and weighs nine ounces. The female which is scarcely so large, has the body of a grey-brown, and the breast whitish-yellow.

Passenger pigeons visit, in enormous flocks, the different parts of North America. In the southern provinces, their numbers greatly depend on the mildness or severity of the season; for, in very genial weather, few or none of them are to be seen. Actuated by necessity, they change their situation in search of acorns, mast, and berries, which the warmer provinces yield in profusion. When they alight, the ground is quickly cleared of all esculent fruits, to the great injury of the hog, and other mast-eating animals. After having devoured everything that has fallen on the surface, they form themselves into a great perpendicular column, and fly round the boughs of trees, from top to bottom, beating down the acorns, of which they are very covetous, with their wings; and they then, in succession, alight on the ground, and again begin to eat.—"I think," says Mr Blackburn, in a letter to Mr Pennant, "that these are as remarkable birds as any in America. They are in vast numbers in all parts; and have, at all times, been of great service to our garrisons, in supplying them with fresh meat, especially at the out-posts. A friend told me, that in the year in which Quebec was taken, the whole army was supplied with this subsistence. The way was this;—every man took his club, (for they were forbidden to use their fire-locks,) and the pigeons flew in such numbers, that each person could kill as many as he wanted. They, in general, begin to fly soon after day-break, and continue till nine or ten o'clock; and again about three in the afternoon, and continue till five or six; but, what is very remarkable, their course is always westerly. The times of flying here are in the spring, about the latter end of February, or the beginning of March, and they continue their flight every day for eight or ten days; and again in the fall, when they appear at the latter end of July, or the beginning of August. The inhabitants catch vast numbers of them in clap-nets. I have seen them brought to the market at New York by sacksful. People, in general, are very fond of them, and I have heard many say that they think them as good as our common blue pigeon; but I cannot agree in this opinion: the flesh tastes most like that of our queest, or wild pigeon, but it is better. Sir William Johnston told me, that at one shot, with a blunderbuss, he killed *above a hundred and twenty.*

"I must remark a singular fact, that notwithstanding the whole people of a town go out *a-pigeoning*, as they call it, they do not, on some days, kill a single hen bird; and on the very next day not a single cock, (and yet both sexes always fly westerly;) and when this is the case, the people are always assured that there will be a great quantity of them that season."

These pigeons were so numerous when La Hontan was in Canada, that, he says, the bishop had been compelled, more than once, to *exorcise* them, on account of the damage which they committed. Many of the trees are said to have had more pigeons on them than leaves; and, for 18 or 20 days, it was supposed that a sufficient number might have been killed to supply food for 1000 men. A gentleman of the town of Niagara assured Mr Weld, that once, as he was embarking on board a vessel for Toranto, a flight of pigeons was observed coming from that quarter; that, as he sailed over lake Ontario to Toranto, 40 miles distant from Niagara, pigeons were seen flying over-head the whole way, in a direction contrary to that in which the vessel proceeded; and that, on his arriving at the place of his destination, the birds were still observed coming from the north, in as large bodies as had been noticed at any time during the voyage. Supposing, therefore, that these pigeons moved no faster than the vessel, the flight must have been extended at least 80 miles.

During their migrations, these pigeons are very fat. In the craw of one of them, Mr St. John found some indigested rice, when the nearest rice-fields were, at least, 560 miles from his habitation; whence he inferred, either that they fly with extreme celerity, or that digestion is in a great measure suspended during their flight.

The Indians often watch the roosting-places of these birds, and, knocking them on the head in the night, bring them away by thousands. They preserve the oil, or fat, which they use instead of butter. By the Europeans, they are generally caught in nets extended on the ground, and to which they are allured by tamed pigeons of their own species, that are blinded, and fastened to a long string. The short flights, and repeated calls of the shackled birds, never fail, either to excite their curiosity, or to bring some of them down to attempt their relief, when they are immediately enclosed. When M. du Pratz was in America, he placed under the roosting-trees vessels filled with flaming sulphur, the fumes of which brought the pigeons to the ground in immense numbers.

We have only to add, that the passage pigeons have two or three hatches in the season, each consisting of two white eggs, like those of the common pigeon; and that the nest consists of some sticks, carelessly put together on a large branch of a lofty tree.

### ORDER X. GALLINACEOUS BIRDS.

Bill short, convex, in some few instances covered with a cere; the upper mandible arched, curved from its base, or only at the point. Nostrils lateral, invested with an arched membrane, and either naked or well covered with feathers. Tarsus long, three toes before, united by a membrane, the hind one articulated higher on the tarsus; but this last toe is, in a few cases, either wanting, or very small.

The birds of this order are, generally, heavy and fleshy. Most of them have short wings; all scratch the earth, and roll in the dust. They feed principally on grains and seeds, but some species eat also berries and buds, and most of them devour insects. Their aliments undergo a first maceration in the crop. They make their nest, with little attention to its arrangement, on the ground, concealed among bushes; and they have several and numerous hatches in the course of the year. The young run and eat as soon as they come out of the shell, and the mother, for some time, conducts and leads them.

*Argus giganteus*, Tem. *A. pavonius*, Vieil. *Phasianus argus*, Lin. Lath. *Gigantic argus*, *Argus pheasant*, or *luen.* Red-brown, spotted with black. The face is red, and behind the head is a blue crest. The wings are grey, and have a great number of eye-like spots. The two middle feathers of the tail are very long, and are spotted through their whole length. The female is brown-black, spotted with yellow and brown, with the webs of the quills blue-black, and the two long feathers without spots. The details of colouring in this beautiful bird, though not particularly brilliant, are finely varied. The size of the body nearly corresponds with that of the turkey hen; but the total length, including that of the intermediate tail feathers, is five feet three inches, the tail feathers alone measuring three feet eight inches; whereas the female, though nearly as large in the body, is only twenty-six inches long, her tail being much shorter than that of the male. These birds occur in many of the northern parts of China, and in several of the interior districts of India and Sumatra. They are extremely wild, and are with great difficulty kept alive for any length of time after they have been taken from the woods. In a strong light, they appear to be dazzled; and when exposed to it, they seem to be melancholy and inanimate; but in the dark they recover all their activity. Their cry is not much unlike that of the peacock, and somewhat plaintive. Their flesh is as savoury as that of the common pheasant, and the wing and tail feathers are in considerable request as ornaments to female head-dresses.

### ORDER XI. ALECTORIDIAN BIRDS.

Bill shorter than, or of the same length with the head, robust, strong, and hard; the upper mandible curved, arched, and often hooked at the point. Feet furnished with long and slender tarsi, three toes before and one behind, the latter articulated further up the tarsus than the others. It has been proposed to subdivide this order into the *field* and *littoral* kinds. The former affect wastes and moors, where they pursue lizards, and other reptiles; and the latter search for insects and worms, and sometimes for fish. The wings of some of them are armed with bony tubercles, or spurs, with which they assail their prey. During flight, they stretch out their legs behind them.

*Psophia crepitans*, Lath. &c. *Agami*, or *Golden trumpeter.*—General plumage black; back grey; breast glossy green; orbits naked, and red; bill yellowish-green; legs strong, tall, brownish-ash, or green; the back toe with a round protuberance beneath; tail very short; feathers of the head downy; those of the lower part of the neck squamiform; of the shoulders ferruginous, lax, pendulous, and silky; and of the scapulas long and hanging. The young preserve their down, or rather their first filamentous feathers, till they have attained to upwards of a fourth part of their growth. The limited extent of the wings of the tail incapacitates the agami for rapid flight; but it runs very quickly in the manner of a partridge; and when it is constrained to use its wings, it rises only a few feet, to repose again at a little distance on the ground, or on the branch of a tree. The female has two or three hatches in the year, each of them consisting of from 10 to 16 eggs, which are almost spherical, a little larger than those of our common fowl, and of a clear green. She deposits them in a hole, which she makes by scratching the soil under a tree, and without collecting any substance for a lining. The full-grown birds measure about 22 inches in length, and their body fully equals in size the domestic fowl.

This species is diffused over all the warmer regions of South America, and is of common occurrence in Guiana, where it is generally met with in pretty numerous bands. These scarcely seek to avoid the sportsman; but their unsuspicious temper is not the effect of stupidity, for few animals are naturally more inclined to associate with man, the agami being, among birds, what the dog is among quadrupeds. When only just emerged from its wild and solitary abodes, it soon acquires, in the house in which it is fed, the qualities of a faithful friend, and of an intelligent servant. It becomes obedient to the voice of its master, follows or precedes him, quits him with regret, and meets him again with the most lively expressions of joy. Sensible to caresses, it returns them with evident symptoms of affection and gratitude; nay, it manifests uneasiness and jealousy, if any person approaches too near its master. It delights in having its head and neck scratched, and is importunate for the repetition of such attention. It distinguishes the friends of the house, and treats them with complacency, but is often surly to strangers, and conceives aversion to particular individuals, without any apparent cause. It obstinately attacks animals that are larger and better armed than itself, and puts them to flight. Sonnini was confidently assured, that, in some districts, it carefully tends the domestic poultry, or even accompanies the sheep to the pasture, and conducts them home in the evening. It is remarkable for the frequent repetition of a shrill cry, somewhat resembling that of the turkey, or of a child's trumpet; by imitating which, they are easily caught or killed. Their flesh, though somewhat dry and tough, is not unpalatable, but that of the young is preferable.

### ORDER XII. CURSORES, OR RUNNERS.

Bill of moderate dimensions, or short; legs long, naked above the knee; only two or three toes directed forwards.

The birds which compose this order live always in the fields, and most frequently in desert regions, remote from woods and bushes. They are polygamous, and subsist on herbage, seeds, and insects. They are either incapable of flight, or they fly little, and near the ground. They run with great fleetness, not only when pursued, but habitually; and differ, in this respect, from the greater number of the waders, which walk with a deliberate step. Such of the present order as can fly, stretch their legs backwards when on wing. They are very shy and wary, and, consequently, their manners are studied with difficulty.

*Rhea Americana*, Lath. Tem. *Struthio Rhea*, Lin. *American rhea*, *American ostrich*, or *nhandu.*—Body white; wings and back obscurely grey; entirely white, or entirely black varieties also occur. About six feet in height, the neck alone measuring two feet eight inches: the wings may be stretched eight feet, from tip to tip, but, on account of the webs being disunited, they are useless in flight. The female is a little smaller. This species is a native of South America, being very common in some of the exposed and flat tracks. It associates either in pairs or bands, the latter of which are sometimes composed of more than 30 individuals. In those parts of the country where they are not hunted, they readily approach rural habitations; but where they are objects of the chase, they become very shy, and get out of sight with great precipitation, so that a person requires to be well mounted, in order to overtake them. In the midst of the chase, they sometimes wheel suddenly about, and elude their pursuer; and when noosed, they kick with great and even dangerous violence. When tranquil, their deportment is grave and majestic, for they hold their head and neck elevated, and their back in a rounded attitude. They swim across rivers and swamps with great ease. The sexes pair in July, when the males utter a sort of lowing. The female begins to lay about the end of August, and the first young ones appear in November. The nest is a wide but shallow hollow, scooped out on the bare ground, and without any attempt at concealment, but sometimes lined with straw. The eggs, which are equally large at both ends, and contain about two pounds of liquid each, have a very white smooth surface, mottled with yellow. The number which each female deposits is not exactly known; for, though 70 or 80 are sometimes found in one nest, these are, doubtless, the produce of several hens; but a single *male*, according to Azara, hatches and rears the brood, and calls them together by a hissing noise. The young which are bred in houses, become immediately familiar, and are of such a prying disposition, that they examine every apartment, and look through the casements to see what is passing in other houses. These domesticated individuals will eat fruits, grain, flies, and even butchers' meat, and, like the ostrich, will swallow indigestible matters that come within their reach. The eggs afford an excellent dish at table, and are also much used in the making of biscuits. As these birds are known to thrive even in cool mountainous districts of considerable elevation, they might, perhaps, be advantageously introduced into some of the temperate regions of Europe.

### Order XIII. Grallae, or Waders.

Bill of various forms, most frequently straight, elongated, conical, and compressed, and rarely depressed or flat. Legs long, slender, more or less naked above the knee, with three toes before and one behind, the latter articulated on the same level with those before or higher up.

These birds are mostly all semi-nocturnal, stalking along the shores of seas, lakes, or rivers, and feeding on fish or their spawn, and on reptiles or insects. Such of them as are furnished with a strong and hard bill subsist on fishes and reptiles, while those with a soft, and more or less flexible bill, feed on worms and insects. They are provided with long wings, adapted to their extensive periodical migrations, which they perform in bands, the old and the young keeping in separate divisions, and all stretching out their legs backwards during flight. Some of them walk slowly and with a measured step, and others run with great swiftness. With some the moulting takes place twice in the year; and there is no very marked difference between the external appearance of the male and female. In general they are very shy and cunning.

*Ciconia alba*, Tem. *Ardea ciconea*, Lin. *Common*, or *White stork*. Bill perfectly straight, smooth naked spot on the cheeks very small, and not communicating with the bill, plumage white. The head, neck, and all the parts of the body, are of a pure white; the scapulas and wings black, the bill and feet red; the naked skin around the eyes is black, and the iris is brown. The feathers on the breast are long and pendulous. Size of the body about that of the turkey, measuring three feet and five or six inches in length, and the extent of outstretched wings six feet. The young have the black of the wings imperfectly tinged with brown, and the bill of a reddish-black. A pure white variety occurs in Bulgaria.

Owing to its consumption of noisome reptiles, its familiar disposition, and its endearing habits, the stork is one of the most popular of littoral birds, and has been generally regarded as the friend of man, attached to his dwellings, nestling on the roofs and chimneys, catering on the banks of the most frequented rivers, and in cultivated fields, nor even shrinking from the bustle of crowded cities, taking up its abode in towers, and every where respected and welcomed. The Dutch protect it, because it checks the multiplication of reptiles in their marshy and humid flats; the Vaudois cherish and venerate it for its friendly offices; the Arabs treat it with the most hospitable regard; and the Turks consider it as a sacred bird which they are forbidden to kill. At Constantinople, accordingly, the storks build their nests in the streets. A mussulman cannot patiently bear to see one of them molested; and the ancient Thessalians made the killing of them a capital crime.

The white stork is of gentle manners, and manifests a sense of cleanliness, secreting its droppings in some sequestered corner. Although its air bespeaks somewhat of a pensive melancholy, it occasionally indulges in gaiety and pastime, associating even with children, and partaking of their amusements. "I saw," says Dr Hermann, "in a garden, in which the children were playing at hide-and-seek, a tame stork join the party, run its turn when touched, and so well distinguish the child who was to pursue the rest, as, along with the others, to be on its guard." It has also the sagacity to engage its companions to avenge a real or fancied injury. Thus, a wild individual of this species was brought by a farmer, who resided near Hamburgh, into his poultry-yard, to associate with a tame one which he had long kept there; but this latter disliking a rival, fell on the poor stranger, and beat him so unmercifully, that he was compelled to take wing, and, with difficulty, effected his escape. About four months afterwards, however, he returned to the poultry-yard, recovered of his wounds, and attended by three other storks, which no sooner alighted than they attacked and killed the tame one. The following adventure at the university of Tubingen, as related by Keysler, is not less remarkable:— "A tame stork had lived quietly in the court-yard, till Count Victor Graveritz, at that time a student there, shot with ball at a stork's nest near the college, and probably wounded the stork in it, as for some weeks he was not observed to stir from his nest. This happened in autumn, when the foreign storks set out on their periodical migration. The following spring a stork was observed on the roof of the college, and, by its continual chattering, gave the tame stork, which was walking in the college court, to understand that it was desirous of his company; but this being impracticable, by reason of its wings being clipped, the stranger with the greatest caution came down to the upper gallery; the next day, somewhat lower; and, lastly, after abundance of ceremonies, alighted in the court. The tame stork, not conscious of any crime, went and met him with a soft cheerful note, a sincere indication of courtesy and friendship, when, to his astonishment, the other furiously attacked him. Some spectators of this rencontre immediately put the strange stork for that time to flight; yet was it so little discouraged, that the very next day it returned to the charge, and, during the whole summer, frequent smirmishes passed between these birds; for Mr T. had given orders that the tame stork, having but one antagonist to deal with, should not be assisted. Being thus put to its shifts, it began to stand better on its guard, and made such a stout resistance, that at the end of the campaign the stranger had little to boast of. But next spring, instead of a single stork came four, which, without any of the foregoing ceremonies, lighted at once in the college court, and made at the tame one. This peaceable fowl, in presence of many spectators from the galleries, performed exploits, if I may be permitted the expression, above the valour of man, defending itself and assaulting its enemies with the most vigorous intrepidity, till at length overpowered, and its strength being spent, it was falling under the redoubled strokes of the enemy, when some very unexpected auxiliaries appeared. All the turkey-cocks, ducks, geese, and the whole posse of fowls which were brought up in the court, and to which this gallant stork had unquestionably endeared itself by its mild and friendly carriage, braving the danger, formed, as it were, a rampart for it, by means of which it might make an honourable retreat from so unequal a fight; even a peacock, which before would never be on good terms with it, on this occasion, however, sided with oppressed innocence, and was, if not a staunch friend, at least a favourable judge on the stork's side. This occasioned a stricter watch to be kept against all such treacherous incursions, and a stop was put to any farther bloodshed, till, in the beginning of the third spring, above 20 storks made a sudden stoop into the court, and before the poor stork's life-guards could form themselves, or any people could come to his assistance, they murdered it: However, under such disparity, it exerted all its former heroism, and made them pay dear for their base assassination. The rancour of these strangers, against the innocent creature, could proceed only from the gun fired by Count Victor, and falsely construed to be done by the instigation of the tame stork."

Among the engaging attributes of the stork, have been justly reckoned gratitude, conjugal fidelity, and filial and parental affection. They seem, in fact, to be very sensible of kind treatment, saluting with a noisy flapping of their wings those houses, the inmates of which had given them a friendly reception during the preceding season, and repeating the same ceremony on taking leave. With wonderful constancy, the same pair return to the same haunts, and join in mutual and fond caresses after their long voyage. The tender solicitude which the female manifests concerning her young, has been proverbial even from remote antiquity. She feeds them for a very considerable period, nor quits them till they are strong enough to defend themselves, and to provide for their own subsistence. When they begin to flutter about the nest, she bears them on her wings, and protects them from danger; and she has been known rather to perish along with them than abandon them to their fate. Young storks, on the other hand, have often been observed to lavish the most affectionate and assiduous care on their aged and infirm parents; and the ancient Greeks, observant of this affecting instinct, enacted a law to compel children to support the authors of their existence, and the guardians of their infant years.

The stork is capable of sustaining a lofty flight, and of performing long journies, even in tempestuous weather. It returns to Alsace about the end of February, to Switzerland in the course of March, and to Germany early in May; but it rarely visits this country. If a pair, on their return, find their former nest deranged, or demolished, they repair it with sticks, rushes, and other plants that grow in moist situations. It is usually placed on high roofs, the battlements of towers, and, sometimes, the tops of tall trees, or the projection of a precipitous rock. In France, it was formerly customary to lay wheels on the roofs of houses, to induce these birds to build on them, a practice which still subsists in some places. In Holland, boxes are still used for the same purpose. The hatch consists of two, three, or four eggs, of a yellowish dirty white, longer than those of the goose, but not so thick. The male sits on them when the female is abroad for food. The young make their appearance in the course of a month, when the parents diligently search and carry to them the requisite aliment, which they disgorge from their gullet or stomach. Both of them never leave their charge at once, but, whilst one forages, the other keeps watch, standing on one leg, and with its eyes fixed on its offspring. The young are, at first, covered with a brown down, and drag themselves in the nest on their knees, their legs being too weak to support them. As their wings grow and acquire strength, the mother aids and trains them in their attempts to fly. At Bagdad, hundreds of storks' nests are to be seen about the houses, walls, and trees, and they abound among the ruins of Persepolis. The stork rests and sleeps on one leg, with its head bent backwards on its shoulders; and in the same attitude it frequently fixes its eye on the reptile which it singles out for prey. Previous to migration, it makes a singular snapping noise with its bill, turning its head backwards, with the upper mandible placed on the rump, and the under set into the quickest motion, and made to act on the other. These birds remove southward about the end of August; but, before their departure, multitudes of them assemble in the plains once a day, make the noise with their bills to which we have just alluded, and move about and bustle among one another, as if consulting and concerting their plans. At an appointed time, and with a northerly wind, they suddenly ascend in a body, and are speedily out of sight, in the higher regions of the air. This movement is seldom remarked, because it sometimes takes place in the night, and always in perfect silence. In Egypt they have a second brood; but many of them remain there throughout the year. In Japan they are likewise stationary. They proceed northward, as far as Sweden, Russia, and Siberia; and they are met with throughout Asia. Their migratory squadrons are very extensive; for Shaw, the traveller, saw three flights of them leaving Egypt, and passing over Mount Carmel, each half a mile in breadth; and he says they were three hours in passing over.

"Who bid the stork, Columbus-like, explore
Heavens not his own, and worlds unknown before?
Who calls the council, states the certain day,
Who forms the phalanx, and who points the way?"

Lastly, we have to remark, that, though easily tamed, storks do not breed in confinement, a circumstance the less to be regretted, because their flesh is far from palatable.

### ORDER XIV. PINNATIFIED, or FIN-FOOTED BIRDS.

Bill middle-sized and straight, with the upper mandible slightly curved at the tip. Legs of moderate dimensions, with slender or compressed tarsi; three toes before and one behind, and the rudiments of webs along the toes.

The birds included in this order are monogamous, but unite in large troops for their periodical voyages, which they perform either by flight or swimming. They swim and dive with equal facility. In general, there is no very marked difference between the male and the female. Their food consists of worms, fish and their spawn, insects, and occasionally vegetables. Their body is covered with an abundant down; and their plumage is close and glossy. Species of all the genera are found in the different quarters of the world.

*Fulica atra*, Lin. including the *Aterrima* of Gmelin, *Common*, *Black*, or *Bald coot*, *Snyth* of the Orcadians.—Front, flesh colour, and tinged with red in the breeding season; bracelets greenish-yellow, body blackish, outer edges of the wings white. There are, however, several varieties, which, by some, have been marked as distinct species. The size of the present is about that of the domestic fowl, length 18 inches, and weight from 20 to 30 ounces. In great Britain it is found throughout the year, and is not supposed to migrate to other countries, but only to change its stations, removing from the pools in which the young have been reared, to the larger lakes, about which they flock together in winter. If the season should prove severe in France, they sometimes wholly disappear, but return again in February. In winter they abound in Sardinia, so much as to cover every pool and lake; and so destructive are they to the young wheat, that the farmers in the neighbourhood of their haunts preferably sow flax, which these birds do not molest in their nocturnal excursions. They breed early in spring, the female generally constructing her nest of a large quantity of coarse dry herbage, as flags and rushes, well matted together, and bound with softer and finer grasses, in a bush of rushes, surrounded by the water. By piling up the materials, she raises the fabric sufficiently above the water to keep the eggs dry; but, as this sort of structure frequently renders it too conspicuous to the buzzard, and other birds of prey, the older females, instructed by experience, place it on the banks of streams, among the tallest flags, where it is better concealed. As it is kept in a buoyant state, a sudden flood, accompanied by a gale of wind, has been known to detach it from its position, and to float it from one side of a large piece of water to the other, as happened in Sir William Middleton's lake at Belsay, in Northumberland, notwithstanding which the female continued to sit, as usual, and brought out her young in her moveable habitation. The females have, generally, two hatches in the year, each consisting of from twelve even to twenty eggs, which are about the size of those of a pullet, and of a pale brownish-white, sprinkled with numerous dark spots, which run into blotches at the thicker end. The incubation lasts twenty-two or twenty-three days. As soon as the young quit the shell, they plunge into the water, dive, and swim about with great ease: and though they do not return to the nest, nor take shelter under their mother's wings, they still flock around her for some time, and skulk under the flags. At first they are covered with a sooty down, and have a shapeless appearance; and, before they have learned to shun their enemies, they are often sacrificed to the rapacity of the pike, or to the moor-buzzard, kite, &c. This species breeds abundantly in the isle of Sheppey, where the inhabitants protect the eggs, as the birds form a considerable article of food. The French eat them on meagre days; but though skinned before dressing, they are not very generally relished. In Holland, the eggs are publicly sold in the market, and fetch a considerable price. The common coot is a bad traveller, and waddles from one pool to another with a laboured and awkward gait. During the day, it usually lies concealed among the water plants, rarely venturing abroad, except in the dusk, or at night, in quest of herbage, insects, &c. the light probably dazzling its imperfect vision. The sportsman and his dog can seldom force it from its retreat, as it will rather bury itself in the mud than spring up; or, if very closely pursued, and compelled to rise, it moves with much fluttering, and apparent uneasiness.

### ORDER XV. PALMIPED, OR WEB-FOOTED BIRDS.

Bill of various forms. Legs short, placed more or less backwards; fore toes half furnished with scalloped membranes, or quite connected by webs, but in some families the fore toes are united by a single membrane; the hinder toe interiorly articulated to the tarsus, and, in some cases, wanting.

The greater number of families included in this order frequent the sea, or its shores. Some of them repose on the surface of the water, fly more frequently than swim, and never dive; others both swim and dive with the greatest ease, and a few live much in the liquid element, ascending to the surface to breathe, and never appearing on the land, except in the breeding season. Most of them subsist on fish or their spawn, testacea, and marine insects; but the goose and swan tribes, and some of the ducks, are not averse to a vegetable diet. They nestle in holes and crevices of rocks, or simply on the beach. Their body is furnished with a very thick down, and a profuse, compact, and glossy plumage. The majority of them moult twice a-year, and the females, in some instances, later than the males. With a few exceptions, the outward appearance of the male and female is not materially different; but the young are generally so unlike the adults, as to have been often mistaken for different species.

*Diomedea exulans*, Lin. &c. *Wandering albatross*, or *Man-of-war bird*, *Cape sheep* of mariners.—Mantle grey-brown, with black hatchings on the back and wings, all the under parts of the body white, bill yellowish, legs reddish-brown, tail rounded and plumbeous. But the colours of the plumage are not constant. The black variety mentioned by some authors is the young. From three and a half to four feet long; extent of wing from ten to thirteen feet; size about that of a swan, or sometimes larger, and the weight from 12 to 28 pounds. Its mode of flight is somewhat remarkable; for one cannot perceive any motion of its wings, except at the moment when it raises itself into the air, when it also frequently makes several strokes against the water with its feet. This impulse being once given, it seems to have no longer occasion to flap its wings, but it holds them very widely expanded, whilst it glides along, balancing its body, alternately, from right to left, and from left to right, and skimming rapidly over the surface of the sea in quest of food. It is extremely voracious, preying on fishes, which it swallows whole, and in such quantities as to be occasionally prevented, by their weight, from rising. It particularly pursues the salmon in the mouths of rivers, and darts on the flying-fish, when out of the water. It feeds, likewise, on molluscous animals, but is itself attacked by the sea eagle, the skua gull, and other birds of prey, its courage being very disproportioned to its dimensions. When encumbered with an overloaded stomach, these birds, on the approach of a boat, or other alarm, disgorge the yet indigested morsels, that they may the more easily fly off. But they seldom soar aloft, except in stormy weather; yet they may often be seen, at a great distance from land, reposing or sleeping on the water, or alighting on the rigging of ships. Their cry has been compared to that of the pelican; and they sometimes utter a noise like the braying of an ass. Although they are met with in most seas, they chiefly occur between the tropics, at the Cape of Good Hope, and among the icy islands of the South sea. Towards the end of June, they likewise migrate in thousands to the coasts of Kamtschatka, the sea of Okotsk, the Kurile Archipelago, and Bhering's island, arriving in a state of extreme leanness, but soon acquiring plumpness by their abundant captures of fish at the mouths of rivers. They breed on the ridges of the Aleutian islands, composing their nest chiefly of feathers. On the coast of South America, they collect heaps of earth or mud, from one to three feet above the ground, whereas in Tristan d'Acunha, according to Captain Carmichael, they merely select a dry spot of ground, and give it a slight concavity, to prevent the solitary egg from rolling out of its place. This egg is white, very long in proportion to its diameter, and almost equally thick at both ends. Although eatable, its white portion is said not to coagulate by boiling. Mariners who have been long deprived of the comfort of fresh provisions, sometimes contrive to eat the birds themselves with relish, by previously skinning them, then steeping them for twenty-four hours in salt water, boiling them, and serving them up with some pungent sauce. A piece of sheep's skin, put on a large hook, will often suffice as a bait. When taken they toss themselves about with great violence, and endeavour to assail their captors with their bill. Many of the Indians set a high value on the feathers of these birds, which they use for arrows, on account of their superior durability. The natives of the South sea islands watch the arrival of the albatrosses at the rainy season; and when they observe them, they launch from their canoes into the water a light float of wood, baited with a small fish. When one of the birds approaches it, a man stands ready with a pole about eighteen feet in length, and seldom fails in bringing it down. If, however, he should miss his aim, he must wait for another bird; for that at which he aimed will no longer be tempted within his reach. The cock birds are reckoned the most valuable, and one of them is sometimes exchanged for a large hog. Of the intestines of the albatross, blown up like bladders, the Kamtschadales make buoys to their fishing nets: of the wing-bones, they make tobacco pipes, needle cases, &c. In the West Indies, the appearance of these birds is said to foretel the arrival of ships, a prediction which is not altogether fanciful; for, as the albatrosses fish in fine weather, should the wind happen to be boisterous out at sea, they retire into the harbours, where they are protected by the land; and the same gale which blows them in, frequently also brings vessels to seek a retreat from the storm.

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The foregoing sketch may suffice as a general view of M. Temminck's method of classing birds, and that proposed by M. Cuvier, in his *Regne Animal*, is not without its merits; yet, as the Linnéan arrangement of the same class of animals is still popular in this country, we shall conclude this article by short definitions of his orders, illustrated by summary descriptions of several species already referred to in the order of the alphabet.

The illustrious Swedish naturalist divides the *Aves* into six orders, the distinctions of which are taken chiefly from the bill.

I. ACCIPITRES, or Birds of Prey, having the upper mandibles of the bill furnished, on each side, with an angular process.

II. PICÆ, or Pies, having the bill somewhat compressed and convex.

III. ANSERES, or Web-footed Birds, with a somewhat obtuse bill, covered with a slender skin, gibbous at the base, underneath, and wide at the end, the margins of the base denticulated, the tongue fleshy, and the webbed, or palmated feet, being formed for swimming.

IV. GRALLÆ, or Waders, having the bill somewhat cylindrical and rather obtuse, the tongue entire and fleshy, and the thighs naked for a considerable space above the knees.

V. GALLINÆ, or Poultry, with a convex bill, whose upper mandible receives the edges of the lower, the nostrils half-covered with a cartilaginous convex membrane, the tail-feathers more than twelve, the feet cleft, but the toes connected by a membrane, as far as the inmost joint.

VI. PASSERES, or the Sparrow tribe, comprising birds which have a conical and acuminated bill, with the nostrils oval, open, and naked.

I. The first Order, or ACCIPITRES, may be aptly exemplified by *Falco fulvus*, and *F. palumbarius*. The generic characters of both are, bill hooked, and furnished with a cere at the base, head covered with close set feathers, and the tongue bifid.

1. *Falco fulvus, Ring-tailed, White-tailed,* or *Common eagle.*—It is the *Black eagle* of Pennant, although the plumage is of a dark ferruginous brown; and it includes the *brown* and *black* varieties of Buf-

fon, although they are both of the same brown colour, and distinguished only by shades. The specific characters are, cere yellow, feet downy, and of a rusty brown hue, back brown, and the tail with a white transverse band. In the bill, cere, irides, and legs, it resembles the *chrysœtos*, or golden eagle; but the general plumage is rather darker, and the tail is white for two-thirds of its length; or, if this latter badge varies in breadth, it never entirely disappears, being observable even in the nestlings. The extreme length of the body is about three feet, and the extent of outstretched wing seven feet eight inches. The wings, when folded, reach to near the end of the tail. Though found in America, as far north as Hudson's bay, and more diffused than the golden eagle, it is equally rare in England; but, in the hilly parts of Scotland, it is much more common, and proves destructive to deer, which it will seize between the antlers, and, by incessant blows of its vigorous wings, secure as its prey. It likewise makes great havoc among the white hares and ptarmigans, young rabbits, pigs, &c. As a proof, at the same time, of its capability of enduring hunger, especially when in a state of captivity. Buffon assures us, that one which he saw, taken in a snare, lived about forty days, constantly refusing every kind of nourishment, and appearing to be debilitated only during the last eight days, at the end of which it was killed. Spallanzani has observed, that the common eagle has a great antipathy to bread, and will not touch it, even after a long fast; and yet, when compelled to swallow it, he digests it perfectly. It has been alleged, that eagles, and other predacious birds, never drink water: and it is true, that they can dispense with it for a considerable time; but, when it is presented to them, they plunge and bathe in it, and even sip it, like other birds. So elevated is the flight of this species, that it often disappears from the human sight, though even then its cry may be heard, and it can still distinguish, by its piercing glance, a solitary hare, and dart down on it with the rapidity of an arrow. The male and female usually hunt together; and mountaineers who have observed their manners, allege, that one of the two beats the bushes, while the other lies in ambush, on some eminence, ready to pounce on the game in its flight.

The common eagle builds in high precipices and cliffs. Mr Willoughby thus describes one of its nests found in the Peak of Derbyshire: "In the year of our Lord 1688, in the woodlands, near the river Derwent, in the Peak of Derbyshire, was found an eagle's nest, made of great sticks, resting one end on the ledge of a rock, and the other on two birch trees, upon which was a layer of rushes, and over them a layer of heath, and upon the heath rushes again; upon which lay one young one, and an addle egg, and by them a lamb and a hare, and three heath poults. The nest was about two yards square, and had no hollow in it. The young eagle was as black as a hobby, of the shape of a goshawk, of almost the weight of a goose, rough-footed, or feathered down to the foot, having a white ring about the tail."

It is related in the life of Thuanus, that as he and Monsieur Schomberg were on an embassy from Henry III. to the king of Navarre, they were entertained, for some days together, at Mande, the seat of the Bishop and Count of Gévaudan. At the first repast, it was observed, with some surprise, that all the wild-fowl, or game, brought to table, wanted either a head, a wing, a leg, or some other part, which occasioned their host pleasantly to apologise for the voracity of his caterer, who always took the liberty of first tasting what he had procured, before it was brought to table. On perceiving the increased surprise of his guests, he informed them, that, in the mountainous regions of that country, the eagles were accustomed to build their eyries among the almost inaccessible rocks, which can be ascended only by means of ladders and grappling irons. The peasants, however, when they have discovered a nest, raise a little hut at the foot of a rock, in which they screen themselves from the fury of the birds, when they convey provision to their young, which the male carefully nourishes for the space of three months, and the female continues the employment till they are capable of quitting the eyry. While they continue in the latter, the parents ravage all the country, and bring to the nest capons, chickens, ducks, lambs, kids, pigs, &c. the fields and woods supplying them with pheasants, partridges, woodcocks, wild ducks, hares, fawns, and other choice game. When, therefore, the shepherds perceive that the old eagles have left the eyry, they plant their ladders, climb the rocks, and carry off what the parents have fetched to their young, leaving, instead, the entrails of animals, or other offal; but, as this cannot be done so expeditiously as to prevent the young eagles from devouring a part of what has been brought to them, it follows, that it is generally mutilated: in recompence, however, for this disadvantage, it has a much finer flavour than any thing that the markets can afford. He added, that when the young eagle has acquired strength enough to fly, the shepherds fasten him to the eyry, in order that the parent birds may supply him so much the longer with food; that three or four eagles nests were sufficient to furnish a splendid table throughout the year; and, that, far from murmuring at the ravages of eagles, he reckoned himself very fortunate in being situated in their neighbourhood, and regarded every eyry as a kind of annual-rent.

The female of the present species usually lays two, sometimes only one, and, rarely, three eggs, of a dirty white, speckled with rufous, or reddish. The incubation lasts thirty days. Like the rest of her tribe, the mother drives off the young from the nest, as soon as they are able to shift for themselves. Each pair live in an insulated state, at a respectful distance from others of the same species, and occasionally interrupting their silence by a shrill or lugubrious cry. From their extreme tenacity of the vital principle, has, possibly, originated the eastern notion of the renovation of their youth. Keysler alludes to an individual which lived 104 years at Vienna, though in a state of confinement. In old age, they become more or less hoary, or partially of a pure white; and similar changes are induced by disease, or protracted captivity and hunger. They seem to delight in combat and rapine; and, unless taken when quite young, they are with great difficulty domesticated. Though no longer bred for falconry, a learned professor of Vienna gravely proposes, that they should be trained for the direction of balloons! When once tamed, they will exhibit proofs of docility; but, even then, they are resentful of harsh treatment. A gentleman in the south of Scotland had, not many years ago, a tame eagle, which the keeper, one day, wantonly lashed with a whip. About a week after, this man happening to stop within reach of the chain, the enraged bird flew in his face with so much violence as to wound him dreadfully, and drive him back by the blow, beyond further danger. The eagle's screams alarmed the family, who found the man lying at some distance, and covered with blood, and the bird still pacing and screaming, in a manner not less menacing than imperious; and, shortly afterwards, he broke his chain, and effected his escape.

2. *Falco palumbarius*, including the *gallinarius* and *gentilis* of Gmelin and Latham. *Goshawk.*—Upper parts bluish cinereous; a broad white stripe above the eyes; the under parts white, with transverse bars, and longitudinal lines of dark brown; tail cinereous, with four or five blackish brown bars. The bill is bluish black, the cere yellowish-green, and the iris and the feet are yellow. Length of the female about two feet; size of the male nearly a third less. Like others of the falcon tribe, the goshawk is sometimes entirely white, or nearly so; and sometimes the head only is white, and the rest of the body marked as usual, or with occasional variations. It is a native of almost every quarter of the world, and in this island principally occurs in Scotland. It breeds on the tops of high trees, the female laying four or five eggs, of a bluish white, spotted with fulvous. It flies low, is very destructive of game, pigeons, and poultry, and dashes through the woods after its prey; but if it cannot immediately catch the object of its pursuit, it desists, and perches on a bough, for some other opportunity. It likewise feeds on small birds and mice of various kinds, eagerly devours raw flesh, and will not taste of dressed meat, unless compelled to do so by protracted fasting. It plucks birds very neatly, and tears them in pieces before it eats them, but swallows the pieces entire, and frequently disgorges the indigestible parts of its food, in the form of small pellets. It darts suddenly but obliquely on its prey. The young male and female kept by Buffon, were tamed with great difficulty; and so far from manifesting any mutual attachment, they often fought together very fiercely, until, at length, the female, in a fit of fury, killed her companion, when all the other birds about her were asleep. The natural disposition of the goshawk, according to the Count de Buffon, is so sanguinary, that, if left at liberty with several falcons, it kills them all in detail.

This species was formerly much prized in the sports of falconry, as it was used, not only for the chase of pheasants and partridges, but also of the larger fowl, as wild geese and cranes, and sometimes for rabbits. It is still employed as a bird of sport in some parts of Germany, but more particularly in Tartary and China, where a variety that is mottled with brown and yellow is mostly in use. In his sporting excursions, the emperor of China is usually attended by his grand falconer, and a thousand of inferior rank. Every goshawk has a silver label fastened to its foot, intimating the name of the falconer who has the charge of it, that in case it should stray, it may be restored to the proper person; but, if he should not be found, it is delivered to another officer, who is styled the *guardian of lost birds*; and who, to make his situation generally known, erects his standard in some conspicuous place among the army of hunters.

II. From the PICÆ, we have to select, for description, *Alcedo cristata*, *Corvus corax*, *Corvus pica*, *Merops apiaster*, and *Cuculus canorus*.

1. ALCEDO, or KINGFISHER.—Bill triagonal, thick, straight, long, and acuminated; tongue fleshy, very short, plain, and acute; feet, in most of the species, gressorial. For *A. ispida*, or *Common kingfisher*, see page 486 of this article.

2. *A. cristata*, *Crested Kingfisher.*—Short tailed, sub-crested, blue above, crest waved with black. The upper surface of the wings and the tail are sky-blue, the head is thickly covered with long narrow feathers, neatly dotted with black and greenish points, which rise into a crest; the throat is white: on the side of the neck there is a tawny rufous spot of the same hue with the under parts of the body. The whole bird is scarcely five inches long. It is a native of the Philippine islands, where it is called *Vintsi*, and of Amboyna, where the inhabitants call it *Tohorkey* and *Kito*. According to Sander and Goeze, it has been observed in Germany. It has the habits of its congeners.

3. CORVUS, or the CROW tribe.—Bill strong, upper mandible a little convex, edges cultrated, and, in most species, slightly notched near the tip; nostrils covered with bristles reflected over them; tongue divided at the end; toes, three forward, one backward, and the middle one jointed to the outer, as far as the first joint.

4. *C. corax*. *Raven.*—Black, with a dash of bluish on the back, tail nearly rounded. The young, when hatched, incline to whitish. The ordinary length of the full-grown bird is twenty-two inches and a half, the stretch of wing three feet, and the weight thirty-five or thirty-six ounces, the female being about three or four ounces heavier.

As the raven takes a lofty flight, and is capable of enduring every temperature, it is met with in all latitudes; and its voracity is scarcely less indiscriminate than its residence. The genuine mountain raven is not migratory, but manifests, on the contrary, a partiality to the rock on which it has paired, which is its ordinary station, and which it never entirely abandons. When it descends into the plains, it is for the purpose of procuring subsistence; and this happens more rarely in summer than in winter. These birds do not, like the carrion crows, pass the night in the woods, but retire, in flocks of fifteen, or twenty, to the recesses of rocks, and sleep in the bushes in the clefts. In February or March they build in the crevices, or in holes of walls, or in the bark of large trees, an ample nest, consisting of three distinct layers of materials, the first, or outermost, being composed of branches and roots of shrubs, the second, of the fragments of bones of quadrupeds, and other hard substances, and the third, of a soft lining of grass, moss, or other stuffing. The female lays from two to six, and even, sometimes, eight eggs, of a pale bluish green, marked with numerous spots and streaks of brown and cinereous, and somewhat larger than those of the carrion crow. The incubation lasts about twenty days, during which period the male assiduously waits on his mate, and not only provides her with abundance of food, but takes her place in the nest, for a short time in the day. The young comes forth from the egg with a portion of the yolk included in the abdomen, and which flows insensibly into the intestines by a particular duct; but, after a few days, the mother feeds them with the proper aliments, which undergo a preparation in her crop, and are then disgorged into their bills. If the vigilant male perceives a kite, or other rapacious bird, approaching the nest, he boldly soars above the invader, and, dashing downwards, strikes violently with his bill. Both contend for the mastery, and, sometimes, mount entirely out of sight, until, overcome with fatigue, one or both will fall to the ground. When ravens croak three or four times, repeatedly extending their wings, and shaking the leaves of the tree on which they are perched, they are said to foretel serene weather. In the southern provinces of Sweden, in fine weather, according to Linné, they soar to an immense height, making a clangorous noise that is heard at a great distance; and Mr Pennant adds that, on such occasions, they usually fly in pairs. The Greenlanders, again, observe, that when these birds roam about in a restless manner, they prognosticate a violent south wind and tempest. The ancients studied with the most scrupulous attention the history and manners of the present species, and reckoned sixty-four distinct inflexions of its voice. Besides its native notes and calls, however, the raven possesses the talent of imitating the cry of other animals, and even articulating words when it has been domesticated, and properly trained. It may also be taught to perform little feats, to sing, and to hunt game. Like others of its family, it is notorious for pilfering and hoarding small articles of a glossy or glittering appearance. Its large quills are of great use in tuning the lower notes of harpsichords, and in drawing fine strokes, or executing delicate writing. Few individuals, even among the savage tribes of mankind, eat its flesh; yet in Greenland it forms an article of food, and the skin, with most of the feathers on, is preferred to most other substances for an under garment, while the bill and the claws are used as amulets.

Notwithstanding the injury which ravens sometimes occasion to the farmer, they are often serviceable in destroying noxious insects and vermin; and, in hot countries in particular, they are of signal benefit in the neighbourhood of towns, by devouring the carcasses and refuse, which might otherwise seriously affect the health of the inhabitants.

5. *C. Pica, Magpie, or Pianet.*—Black, with purple and green reflections, the scapulars, breast, belly, and inside of the wing-feathers white. tail lengthened and cuneated; about eighteen inches long, twenty-four in extent of wing, and weighs between eight and nine ounces. The female is somewhat less than the male, and has a shorter tail. Among its more remarkable varieties, we may reckon pure white, and the same colour streaked with black and buff.

The magpie is pretty generally spread over Europe, and large tracts of Asia, but seldom abounds in hilly districts. Its flight is neither so lofty nor so well sustained as that of the rook; nor does it perform long journies, but flies from tree to tree, or from tower to tower, and yet is seldom at rest for any length of time, but skips and hops about, and vibrates its long tail almost incessantly. Though naturally shy and distrustful, it is seldom found remote from human habitations. Magpies generally continue paired throughout the year; or, if they sometimes unite in small flocks, it is only for some temporary purpose, as, for example, roosting during the night. They are clamorous and mischievous,—reject hardly any sort of animal food, or fruits, and will even devour grain, when nothing else happens to be within their reach. They will prey on birds caught in snares, or nestlings, rats, field mice, leverets, feathered game, young poultry, carrion, fish, lambs, and even weakly sheep, which they sometimes succeed in killing, by first plucking out their eyes. Like some of their congeners, they are instinctively addicted to purloin and hoard, not only provisions, but shining trinkets, pieces of money, or such other little articles as they can readily carry off. Their stock of winter food is usually deposited in the middle of a field, and is sometimes indicated by two of the species contending for the possession. The nest, which is placed near the top of a tree, or in a thick bush, or hedge, and sometimes not far from the ground, bespeaks much skill and artifice. The male and female work at it, either conjointly or alternately, beginning in February, and usually continuing their labours for six or eight weeks. It is, for the most part, constructed on a fork, or junction of branches, and composed of twigs, young shoots of trees, and a thick covering of leaves, outwardly strengthened with long and flexible sticks, plastered over with mud, the upper part being covered with thorny branches closely matted, a hole being left in the side, barely sufficient for the admission and egress of the parent birds. Within is a sort of matrass, composed of the fibres of roots, wool, and other soft materials, being only six inches in diameter, whereas the whole structure measures at least two feet in every direction. If the pair continue unmolested, there is but one brood, which generally consists of seven or eight. The eggs are of a bluish or pale green, spotted with brown and cinereous. The incubation lasts about fourteen days; and the young are hatched blind. The parents rear them with the greatest solicitude, and for a considerable length of time. When taken from the nest for training, they may be fed with bread, curdled milk, or new cheese. They readily become familiar, will imitate any singular noise, and may be taught to pronounce words, and even short sentences. In moulting, most of the feathers drop out in succession, but those of the head fall off at once. Their age is supposed scarcely to exceed twenty years. Among the country people, many superstitious notions are con-

Cuckoo tribe.

Cuckoo tribe.

nected with the number of magpies that may happen to appear, and the particular spots on which they are observed.

6. MEROPS, BEE-EATER.—Bill curved, quadrangular, compressed, carinated, pointed; nostrils small, at the base of the bill; tongue slender, the tip generally jagged; feet gressorial.

7. *Merops apiaster, Bee-eater.*—Back ferruginous, belly and tail bluish-green, throat yellow, two of the tail feathers longer than the rest. Nearly as large as the redwing, the total length being about ten or twelve inches, and the stretch of wing seventeen. Next to the roller and king-fisher, it is one of the most elegant of European birds; but its cry is disagreeable. It preferably inhabits the warmer parts of Europe, and various regions both of Asia and Africa. Such of them as penetrate to the north of Europe, move southwards on the approach of winter. They particularly abound in some of the islands of the Levant, as in Candia, and in Southern Russia, especially about the Don and Wolga, whose banks are frequently perforated by their excavations. At the Cape of Good Hope, where they are called *gnat-snappers*, they direct the Hottentots to the honey which the bees store up in the clefts of the rocks. But they likewise pursue various other insects; and, when these fail, they are capable of subsisting on small seeds, and even on wheat. By means of their feet and bill, they dig, in a soft or sandy soil, holes about six feet deep, and in an oblique direction, with a wide entrance and a round bottom. In this last, the female places a nest of moss, laying from four to seven perfectly white eggs, about the size of those of a starling.

"This bird," says Montagu, "does not appear to have been noticed in England till within these few years. In the third volume of the *Linnean Transactions*, an account is given of one of this species having been shot, (for the first time in Great Britain) in July 1794, near Mattishall in the county of Norfolk; which specimen was exhibited before the Linnean Society. A flight of about twenty was seen in June; and the same flight probably (much diminished in number) was seen passing over the same spot in October following. Since the above period, we have been credibly informed more than one have been killed in England."

8. CUCULUS, the CUCKOO tribe.—Bill smooth, a little curved; nostrils bounded by a small rim, tongue furrowed, short, and pointed; feet scansorial.

9. *Cuculus canorus, Common cuckoo.*—Tail rounded, blackish, and dotted with white. When young, the whole body is brownish, and the feathers are edged with white. The full-grown male weighs four ounces and a half, and is fourteen inches long. The female is rather smaller, but has similar markings. The details of their colouring, however, seem to defy description, hardly any two individuals of the species exactly corresponding in this respect. This familiar and welcome harbinger of spring inhabits Europe, Asia, and Africa, occurring as far north as within the arctic circle; and arriving, for the purpose of breeding, earlier or later in different countries, according as the temperature of the climate unfolds the insects on which it feeds. In this island it usually makes its appearance pretty early in April, is silent for a few days, and begins, about the middle of the month, to utter the call from which, in most languages, it has derived its name. This, which is the note of the male, ceases about the end of June. The female occasionally makes a noise that has some resemblance to the cry of the dabchick. It had been erroneously supposed, that the old birds moved southward early in July; but their silence and retirement are occasioned by their moulting, and few of them take their departure till between the 1st and 15th of September; for such as are observed later, are the tardy young, or wounded, or sickly stragglers, the healthy and vigorous shaping their course in flocks to Africa. When on the ground, they have a hopping march; but owing, possibly, to the shortness of their legs and thighs, they seldom alight on the soil.

Cuckoos, for the most part, haunt woods, especially those which are situated on shelving grounds and hills. They are then usually solitary, and apparently restless, perpetually flitting from spot to spot, and rambling about, in all directions, in quest of insects and their larvæ. They likewise eat the eggs of small birds, and discover, with singular sagacity, the best concealed nests. A single cuckoo is not easily approached, and will often exhaust the sportsman's patience, merely by gliding from tree to tree.

A few well authenticated instances of this bird constructing a nest of its own have been recorded. In general, however, the female selects for her purpose that of the hedge-sparrow, or other small insectivorous bird, depositing only one egg in the same nest; or when, as sometimes happens, two have been intruded, they are presumed to have been dropped by different individuals. The young cuckoo, when hatched, receives as much of its supposititious mother's care and attention as her own offspring, and contrives to shove the latter out of their own rightful habitation. When two cuckoos are brought forth in the same nest, they contend fiercely for the mastery, till one of them is killed. The egg is about the size of that of the shrike, with a very thin shell, round, and of a dingy white ground, marked with reddish dots, and some irregularly dispersed black lines. As several are found in the ovaries, it is reasonable to suppose that the female deposits them in different nests. To the late Dr Jenner, one of the greatest benefactors of his race, we are mainly indebted for these and other particulars relative to the breeding of the cuckoo. The young bird, which remains three weeks in the nest, grows rapidly, and is very clamorous for the insect food conveyed to it by its foster parent. If molested, it bristles up its feathers, and assumes a pugnacious attitude. Though not remarkable for sagacity, it is capable of being tamed, and, in confinement, it will eat bread, milk, fruits, and even raw or cooked meat, though not naturally carnivorous. It obviously suffers, however, from captivity, and seldom survives it for any length of time. The Romans greatly prized this bird as an article of food, and the French and Italians eat it at this day, and hold it to be, when fattened, as delicate as the land-rail.

For the rest, much fable and superstition, which it would be idle either to state or to confute, have been mixed up with the natural history of the cuckoo.

III. Under ANSERES, we propose to notice *Anas Anser, Anas Boschas, Alca Alle, Pelicanus Carbo, Colymbus Grylle*, and *Larus Canus*.

1. ANAS, the DUCK tribe.—Bill convex, obtuse, the edges divided into lamellated teeth; tongue fringed and obtuse; the three fore toes connected, the hind one detached.

2. *Anas Anser, Gray-lag goose*, or *Wild goose*.—Bill semicylindrical; body cinereous above, paler beneath; neck striated; bill flesh-coloured, and tipt with white; rump and vent white; legs flesh-coloured; claws black; wants the wing-spot. Inhabits the eastern and central parts of Europe, and, according to Latham, all the quarters of the world. The wild goose commonly weighs about eight or nine pounds, and measures 33 inches in length. In consequence, however, of domestication and copious diet, it acquires larger dimensions; and it has sometimes, by very barbarous processes, been fattened to the weight of 30 pounds. The markings of the plumage are also very considerably diversified in the reclaimed individuals, some being pure white, others black, and the greater number of various mixed and intermediate shades. Monstrous births, too, are said to occur more frequently among geese than among other domesticated birds, owing, perhaps, to the facility with which they acquire fat, which is apt to interfere with the generative functions. The flight of the wild flocks, which is very elevated, is conducted with great regularity, either in one or two lines, uniting at an angle in the middle. When the leader of the squadron is tired with cleaving the air, he falls back into the rear, and the next in order takes his place. These bands usually consist of from 50 to 100 individuals; and the incessant clamour which accompanies their movements may frequently be heard when the birds themselves are beyond the reach of human vision. Occasionally they alight to rest for an hour or two, when one of them sounds a long and loud note, and all are instantly on the wing again. Their principal food consists of aquatic vegetables and most kinds of grain. They can feed, indeed, on grass, and a great variety of herbs; but they are partial to trefoil, fenugreek, vetches, succory, and lettuce, which last is the greatest regale of the goslings. Wild geese breed in heaths, or marshy plains, as in the fens of Lincoln; the female, which takes the sole charge of the eggs and young, nestling on tufts of cut rushes or dry herbage, and generally laying from five to eight, and rarely so many as 12 or 14 eggs, of a soiled greenish hue, which are hatched in 28 or 30 days.

As an important department of the poultry establishment, the goose, we need hardly observe, is cultivated in almost every civilized country, and, when under proper management, forms a profitable article of the farmer's produce, its quills, down, flesh, fat, and even dung, being all turned to account. Its gabbling noise, heavy aspect, and solemn gait, have rendered its name proverbially synonymous with silliness and stupidity: yet its habits of vigilance, which saved Rome from the Gauls, the accuracy with which flocks of them return to their respective homes, among the Cossacs of the Don, from their breeding stations on the northern lakes, and the docility with which they march under the guidance of the *goose-herd*, all bespeak intelligence; and the following, among other anecdotes that might be quoted, sufficiently attests that the goose is even susceptible of gratitude and affection to man. "We give this note," says Buffon, "in the artless and animated style of the keeper of *Ris*, an estate belonging to M. Annison Duperon, and the scene of this faithful and unshaken friendship. 'Emmanuel was asked, how the white gander, called *Jacquot*, was tamed by him? It is proper to observe that there were two ganders, a grey and a white, with three females; these two males were perpetually contending for the company of these three dames; when one or the other prevailed, he assumed the direction of them, and hindered the other from approaching. He who was master during the night would not yield in the morning, and the two gallants fought so furiously that it was necessary to run and part them. It happened one day, that, being drawn to the bottom of the garden by their cries, I found them with their necks entwined, striking their wings with rapidity and astonishing force; the three females turned round, as wishing to separate them, but without effect; at last the white gander was worsted, overthrown, and ill-treated by the other. I parted them, fortunately for the white one, which would have lost his life; when the gray gander set a-screaming, and gabbling, and clapping his wings, and ran to join his mistresses, giving each a noisy salute, to which the three ladies replied, ranging themselves at the same time round him. Meanwhile, poor *Jacquot* was in a pitiable case, and retiring, sadly vented his doleful cries at a distance. It was several days before he recovered from his dejection, during which time I had occasion to pass through the court in which he stayed; I saw him always thrust out from society, and every time that I passed, he came gabbling to me, no doubt to thank me for the succour which I had given him on his defeat. One day he approached so near me, shewing so much friendship, that I could not help carressing him by stroking with my hand his back and neck, to which he seemed so sensible as to follow me into the entrance of the court. Next day, as I again passed, he ran to me, and I gave him the same carresses, with which he could not be satiated; but he seemed by his gestures to desire that I should lead him to his dear mates. I, accordingly, did lead him to their quarter; and, on his arrival, he began his vociferations, and directly addressed the three females, who failed not to answer him. Immediately the gray victor sprung on *Jacquot*: I left them for a moment; the gray was always the stronger; I took part with my *Jacquot*, who was under; I set him over his rival, but he was thrown down; I set him up again—in this way he fought eleven minutes, and by the assistance which I gave, he obtained the advantage over the gray gander, and got possession of the three females. When my friend, *Jacquot*, saw himself master, he would not venture to leave his partners, and, therefore, no longer came to me when I passed; he only gave me at a distance

Duck tribe.

many tokens of friendship, shouting and clapping his wings, but would not quit his prey, for fear that another should take possession. Things went on in this way till the breeding season, and he never gabbled to me but at a distance; when, however, his females began to sit, he left them, and redoubled his friendship to me. One day, having followed me as far as the ice-house, at the top of the park, the place where I should have parted with him, in pursuing my way to the wood of Orangis, at half a league's distance, I shut him in the park: he no sooner saw himself separated from me, than he uttered strange cries. I went, however, on my road, and I was about a third advanced, when the noise of a heavy flight made me turn round my head; I saw my *Jacquot* four paces from me: he followed me all the road, partly on foot, partly on wing, getting before me and stopping at the cross paths, to see what way I should take. Our expedition lasted from ten o'clock in the morning till eight in the evening, and yet my companion followed me through all the windings of the wood, without seeming to be tired. After this, he followed and attended me everywhere, so as to become troublesome, I not being able to go to any place without his tracing my steps,—so that, one day, he came to find me in the church; another time, as he was passing by the rector's window, he heard me talking in the room, and, as he found the door open, he entered, climbed up the stairs, and, marching in, he gave a loud burst of joy, to the rector's no small alarm.

"I am sorry, in relating such pleasing traits of my good and faithful friend *Jacquot*, when I think that it was myself who first dissolved the sweet friendship; but it was necessary that I should separate him by force: poor *Jacquot* fancied himself as free in the best apartments as in his own; and, after several accidents of that kind, he was shut up, and I saw him no more. His inquietude lasted above a year, and he died of vexation. He was become as dry as a bit of wood, as I was told, for I would not see him; and his death was concealed from me more than two months. Were I to recount all the amicable incidents between me and poor *Jacquot*, I should not, in four days, have done writing. He died in the third year of the reign of friendship, aged seven years and two months."

The goose is not often allowed to attain to old age; but some instances are said to have occurred of its completing a century.

3. *Anas boschas*, *Mallard*, or *Wild duck*.—Cinereous; the middle tail-feathers of the male curled back; bill straight, collar white; length, twenty-two or twenty-three inches; extent of wing, two feet ten inches, and weight about two pounds and a-half. The females, and the males before their first moult, are of a more sober brown hue than the adult males; and the varieties and diversities, originating in domestication, are too numerous to be specified. In general, the head of the drake is glossed with a rich emerald green, and his wing decorated with a brilliant spot. On the middle of the neck there is a white half-collar, while the fine purple brown of the breast, and the colours on other parts of the body are disposed in pleasing gradations, and form, on the whole, a beautiful plumage. The vivacity of these colours, however, is most conspicuous in wild individuals.

Duck tribe.

The mallard is abundantly diffused over many of the marshy and inundated tracts of the world. Early in winter, they appear in our latitudes, at first, in small and unfrequent flocks, but, afterwards, in more numerous bands, distinguished by the oblique lines and regular triangles which they form in the air. When all have arrived from their northern haunts, they are seen continually flying from one pool or river to another; and it is then that the fowler is most intent on ensnaring or destroying them; but his devices of decoy and annoyance, which are both multiplied and ingenious, require to be practised with circumspection; for these birds are extremely shy and distrustful, never alighting till they have made several wheels round the spot, as if anxious to survey it, and ascertain if there be any lurking danger. Again, when they settle, they take every precaution, bending their flight, and darting obliquely on the surface of the water, which they graze and skim, then swimming at large at a distance, some of them, meanwhile, stationed as sentinels, and giving alarm, when apprehensive of danger, so that the sportsman is often deceived, and sees them rise before he can fire. Yet, if he reckons himself sufficiently near, he need not be precipitate; for the wild duck springs vertically, and does not get so soon out of reach as a bird that shoots directly onwards. These birds, too, we have to remark, are more active during the night than in the day, feeding, journeying, arriving and departing chiefly in the evening and in the night, and reposing in the daytime, unless roused to flight by sportsmen or birds of prey. The rustling of their wings marks their course, and is most noisy at their rising. As long as the season continues mild, aquatic insects and small fish, frogs that have not retreated under the mud, the seeds of the bulrush, the water-lentil, &c. afford them abundant subsistence: but when the standing waters are frozen over, they resort to running streams, and afterwards to the outskirts of woods to pick up acorns. Some of them reside all the year in our temperate latitudes, breeding in our fens and marshes. In early spring, the males begin to court the females; and the pairing lasts three weeks. The male is said to select a proper spot for the nest, which is generally a thick tuft of rushes, raised and insulated in the middle of the marsh. The female pierces this tuft, deepens it, and moulds it into the shape of a nest, by pressing down the rushes that encumber it. But although wild ducks, and other water-fowls, prefer the vicinity of water for breeding, yet some of their nests are met with among heaths, in the cultivated fields, in mutilated oaks, or in forsaken nests. Each breeding duck lays from about ten to fifteen, and even sometimes eighteen eggs, which are very obtuse and spheroidal, with a hard and whitish shell, greenish albumen, and reddish yolk. It is remarked, that the old ducks lay more, and begin earlier, than the young ones. As often as the female rises from her eggs, even for a short time, she covers them with the down which she pulls from her own breast, for lining to the nest. It has also been observed, that she never alights on them from the wing, but about a hundred paces beyond the spot, and walks to it warily, and with a watchful eye; but when once she is seated on her eggs, even the approach of a man will not flush her. The male keeps at a short distance, accompanies his mate when she goes in quest of food, and protects her from the importunities of other males. The incubation lasts thirty days; all the young are hatched on the same day, and, on the following, the mother calls them into the water. Timorous and chilly, they hesitate to enter; but the boldest plunges after its mother, and the rest soon follow. When the nest is much elevated, or situated at a distance from the water, both parents take them in their bill, one after another, and convey them to their liquid element. In the evening, the mother gathers them together, and withdraws them among the reeds, cherishing them under her wings during the night. All day, they watch on the surface of the water, or on the grassy mead, for gnats, which are their first food; and they are seen to dive, to swim, and to make many evolutions on the water, with equal promptitude and facility. For the first six weeks, the wings are short and mishapen, and the duckling can hardly attempt to fly for three months. The male, as in all water-fowl, with a broad bill and palmated feet, is larger than the female. In their rapid moulting, their great feathers drop in a few days, and often in the course of a single night. The males are thus affected soon after pairing, and the females after incubation, when they are dull and dispirited for about thirty days.

The flesh of the wild duck is finer, and of a more delicate flavour than that of the tame; but some varieties and breeds of the latter, when fed and fattened according to rule, are also highly prized by the epicure. Without free access to water, none of the reclaimed varieties will thrive.

Mr Bakewell mentions the following instance of sagacity, in some ducks, that happened to be collected about his carriage, at Villeneuve, in the Vallais. "On throwing out," says this intelligent traveller, "pieces of hard biscuit, which were too large for them to swallow whole, they made many efforts to break them with their beaks; failing in this, the younger ones gave up the spoil, but some of the older ducks carried pieces of the biscuit to a pool of standing water, and held them to soak, till sufficiently soft to be broken and swallowed with great facility."

4. *Alca, Auk.*—Bill toothless, short, compressed, convex, often transversely furrowed, lower mandible gibbous near the base; nostrils linear; legs, in most cases, three-toed.

5. *Alca alle, Rotche, Little auk, Little black and white diver, Greenland dove, Sea-turtle,* &c.—Bill unfurrowed and conical; abdomen and tips of the flag-feathers white; feet black. There is a variety that is totally white, and another with a rufous breast. These birds inhabit the northern seas, at least as high as latitude 76°, where they abound in the channels between the floes of ice, whence they are also called *ice-birds.* During storms or intense colds some of them move into more southerly climates, but very few of them breed on our shores. They feed much on a small species of *cancer,* and they breed in the holes and crevices of craggy rocks, without any formal preparation of a nest, the female laying one blueish-green egg, generally spotless, though sometimes minutely sprinkled with dusky. Captain Ross encountered myriads of rotches in the frozen seas through which he navigated; and in July and August the ship's company were daily supplied with them, as they were found to be a palateable food, and destitute of any fishy flavour. On the 3d of July 1822, and in north latitude about 71°, Captain Scoresby observed an immense number of these birds flying past his ship towards the west. For many hours in succession, from one to three flocks passed in a minute, all winging their way in the same direction, nearly half a million of them appearing within sight in the course of twelve hours. As soon, in fact, as the ice of the arctic coasts begins to clear away, these and other sea-fowl approach them in multitudes, as they not only find in the water a copious supply of shrimps and small animals on which they subsist, but on the land that warmth and tranquillity which are suited to the exigences of incubation. Towards the end of August, or the beginning of September, they migrate southward, taking advantage of a northerly gale to facilitate their progress. "The whole of the birds, in the breeding season," observes Captain Sabine, "(the sexes being alike,) had the under part of the neck an uniform sooty black, terminating abruptly and in an even line against the white of the belly. The young birds, which we saw in all stages from the egg, as soon as they were feathered were marked exactly as the mature birds; but in the third week of September, when we were on our passage down the American coast, every specimen, whether old or young, was observed to be in change; and in the course of a few days, the entire feathers of the throat and cheeks, and of the under part of the neck, had become white. This latter state has been erroneously considered by some authors as that of the immature bird. It has been correctly described, however, by Fabricius, as the winter plumage.

6. *Pelicanus, Pelican.*—Bill straight, bent at the point, and furnished with a nail; nostrils almost obliterated slits; face somewhat naked; legs balancing the body equally; the four toes connected by a membrane.

7. *Pelicanus carbo, Corvorant,* or more corruptly *Cormorant.*—Tail rounded, body black, head somewhat crested, bill blackish, base of the lower mandibles covered with a yellowish skin, dilatable under the chin; legs black; about the size of a goose, but more slender; weighs from five to seven pounds; measures about thirty inches in length, and from four to four and a half feet in extent of wing. This species resides in most countries that confine on the sea, being extremely greedy of fish, and tolerant both of heat and cold. It is far from uncommon on some of our own shores, where a group of them may occasionally be seen on the rocks, drying their expanded wings in the wind. In this attitude they will sometimes remain for nearly an hour, and then trim

their feathers with the oil which nature has provided for the purpose. Previously to this ceremony they will beat the water violently with their wings ten or twenty times, with short intervals of rest, whilst each beating is succeeded by a vibration of the whole frame, a ruffling of all the feathers, and a general covering of the body with water. Though it dives and swims under water with great activity in pursuit of its prey, which it seldom fails to capture, the corvorant is sluggish when sated with food. Owing, however, to the rapidity of its digestion, it often returns to the charge, and will readily despatch eight or ten pounds of fish in a day. The female makes her nest of sticks, sea-ware, and grass, on the heights of precipitous cliffs, and lays three or more green eggs, of the size of those of a goose. In winter, these birds disperse along the shores, and even visit the rivers, making great havoc among the fresh-water fishes. Although popularly regarded as birds of malignant omen, they have been repeatedly trained to fishing for families; and Mr Montagu mentions various interesting particulars of one which was surprized by a Newfoundland dog, and became tame at once, being in perfect harmony with a whistling swan, a bernacle goose, various sorts of ducks, and other birds. When it got out of the house it never rambled to any distance, but entered of itself at the first open door, regardless even of the dog. Although the flesh of the present species has a rank smell and offensive flavour, the young birds, when stewed or made into soup, are said to be no despicable fare, and some of our navigators have even been reconciled to the old ones.

8. Colymbus.—Bill toothless, subulate, straight, and pointed; throat toothed; nostrils linear at the base of the bill; feet placed far behind,

9. *Colymbus grylle*, *Black* or *Spotted guillemot*, &c.—Bill black; inside of the mouth and legs red; breast and abdomen perfectly black. The other particulars of marking are incident to great variety, owing chiefly to the changes which the bird undergoes in winter; for, on the approach of that season, it becomes mottled with black and white: in spring the plumage gradually resumes the black. The mature male measures thirteen inches in length, and 22 in stretch of wing, and weighs about 14 ounces. It inhabits the northern regions, and migrates in winter to more southern latitudes, but is seldom seen on shore. In the bay of Dublin, which it frequents, it remains throughout the year. In March, it visits the Bass, St Kilda, the Faroe islands, &c. The female makes her nest far under ground, and lays one oblong egg, of a dirty white, blotched with large and small spots of black and cinereous, which are crowded near one of the ends. The black guillemot lives on fish, flies low, and generally in pairs. It is said to rise from the ground with difficulty. Its feathers are dense and close, and so imbued in the oil secreted for their lubrication as to have a very rancid smell. The Greenlanders eat the flesh, and convert the skin into garments.

10. Larus, Gull.—Bill straight, sharp edged, a little hooked at the point, and without teeth; lower mandible gibbous below the point; nostrils linear, broadest on the fore part, and placed in the middle of the bill.

11. *Larus canus*, *Common gull*.—White, back hoary, primary quill-feathers black at the ends, the fourth and fifth with a black spot at the tip, the outer one black without; bill yellow, irides hazel; legs greenish-white; size of a pigeon; weighing about a pound, and measuring from sixteen to seventeen inches in length, and three feet five inches in expanse of wing. The common gull inhabits Europe and America, living on fish, vermes, insects, and their larvæ, &c. breeding among the rocks or stones on the shore, and laying two eggs nearly the size of those of the domestic fowl, but of an olive brown, blotched with dark reddish. These birds often assemble at the mouths of large rivers, for picking up the animal substances that are thrown on shore. At particular seasons they also resort to the inland parts of the country to feed on worms, &c., and, in severe weather, they will consort with rooks, and follow the plough, for the larvæ of the chafer. In default of fish or worms, they will, when pressed with hunger, pick up grain. On the least alarm they very readily disgorge, and promptly re-swallow the rejected morsels when their flight is over. When tamed, they make excellent snail-hunters in a garden. Some people do not disrelish the flesh of this and other species of gulls, especially when it has been washed in vinegar or buried for a day in fresh mould. The *vars*, or flat rocks on the coast of Norway, yield a considerable profit from the eggs of the numerous sea-fowl, and particularly of this species, which breed on them. These birds do not readily leave a place which they have once selected; insomuch that, when the possessors of the var come in quest of the eggs, the female knows them and remains quiet, for it has learned, by experience, that the superfluous eggs only are taken away, and that one is always left in the nest. It only flies, therefore, to a short distance, looks calmly at the act of spoliation, and returns when the plunderers are gone. But the crews of foreign vessels and strangers frequently fall on the var, and rob it of all the eggs, when the whole flock, to the number of many thousands, rise at once, and fill the air with the most hideous and lamentable cries. In their despair they fall down again on their respective nests, and for a long time are inconsolable. If this robbery is repeated they lose all patience, and forsake in a body the inhospitable station for another which seems to promise them more protection and quiet.

IV. Of the Grallae, we have to notice *Rallus crex*, *Cancroma cancrophaga*, *Haematopus ostralegus*, *Ardea virgo*, and *Fulica naevia*.

1. Rallus, Rail.—Bill thickish at the base, attenuated on the back, towards the tip, compressed, a little incurved and pointed; tongue rough at the tip; body compressed, short; feet four-toed and cleft.

2. *Rallus crex*, *Land-rail*, *Corncrake*, *Daker-hen*, &c.—Wings reddish rusty, bill and legs brown-ash, irides hazel, feathers of the body reddish-brown, the upper ones black in the middle, chin very pale, belly whitish-yellow; about nine inches and a half long; weight from six to eight ounces, and extent of wing

16 inches. From the well known call of the male, resembling the noise produced by drawing the fingers along the teeth of a comb, this bird has, in most languages, derived its popular appellation; as it appears, too, at the same time with the quails, frequents the same places, and has been erroneously supposed to conduct them, it has also been denominated *King of the quails*. With us its cry is heard as soon as the grass, clover, or corn can afford it cover, for it arrives about the end of April or the beginning of May, and departs about the middle of September; but how, with its short wings and awkward powers of flight, which it so seldom exercises to any extent, it is enabled to effect its passage even across the British channel, it is difficult to conceive. In most cases of emergency it seems to trust to the extraordinary swiftness of its feet, and to its doublings and windings, so as often to foil both the sportsman and his dog. Besides corn and herbage, it likewise haunts the furze or broom of commons and heaths. The nest is carelessly formed of moss or dry grass, generally in a hollow among thick herbage, and contains about seven or more eggs, of a reddish cinereous white, marked with rusty and ash-coloured spots and blotches. The young run about as soon as hatched. The species subsists on various insects, slugs, and seeds of plants. It has been observed, that it is more numerous in some years than in others. An artificial call, resembling its natural cry, is successfully used as a decoy. The land-rail, when fat, is reckoned a delicate morsel for the table.

3. CANCROMA, BOAT-BILL.—Bill gibbous, and shaped like an inverted boat; nostrils small, and placed in a furrow; tongue small; toes divided.

4. *Cancroma Cancrophaga*, and *Cochlearia* of Linné, *Crested boat-bill*.—It has also been called *spoon-bill*, from the resemblance to two spoons applied to each other at the concave sides. On the convexity of the upper mandible there are two deep grooves, which are sent off from the nostrils, and produced so that the middle space makes a high ridge, terminated by a small hooked point. The lower mandible, on which the upper is fitted, may be said to be the frame on which the skin, prolonged from the throat, is extended. Both mandibles are sharp at the edges, and consist of a solid and very hard horn. Notwithstanding this singular and formidable weapon, the boat-bill is a mild and peaceful bird, frequenting the rivers and flooded savannahs of Brazil and Guiana, and watching on trees for fish and crabs, on which it principally subsists, darting on them from above. Its history, however, would require further elucidation.

5. HAEMATOPUS.—Bill compressed, with the tip forming an equal wedge; nostrils linear; tongue a third part as long as the bill; feet formed for running, three-toed, and cleft.

6. *Haematopus ostralegus*, *Pied oyster-catcher*, or *Sea-pie*.—Bill, eye-lids, and legs red, the bill sometimes tipt with black; irides scarlet; body occasionally all black, but frequently black above and white beneath; a small white spot under the eyes; the breast with a white semicircular band, tips of the middle and greater wing coverts entirely white; quill-feathers spotted with white on the inside; tail, from the middle to the base, white; claws black. Weight seventeen ounces, length sixteen inches. About the size of the crow.

The oyster-catchers occur not unfrequently along the sea-shores of Europe, the basins of the Caspian, in some parts of North and South America, in Senegal, and even in the South sea islands. In autumn they abound in particular districts of the coasts of Holland and of Great Britain; but they are more rare on the French shores; and in winter they seem mostly to retire into the interior regions of the country, or to move southwards. They feed on marine insects, shell-fish, and mollusca, and with their bill, which is so admirably contrived for the purpose, they open the shells of oysters, and detach limpets, &c. from the rocks with singular promptitude and dexterity. They have been known, at the recess of the tide, to rip up flounders in the nets, and pick out indigested shell-fish from their stomach. They are capable of swimming, and can bear to be tossed on the waves, as they can regain the land at pleasure. When congregated or alarmed, they are particularly clamorous. The female makes no nest, but deposits four eggs of the size of those of the lapwing of an olivaceous brown, blotched with black, on the pebbly or grassy beach, a little above high-water mark, with the small ends inwards, so as to give the greatest security and warmth to each. The incubation lasts twenty or twenty-one days; but in hot and dry weather the female occasionally leaves the eggs, from nine or ten o'clock in the morning till three in the afternoon. The watchful male, on the least alarm, utters a loud scream and flies off, as the female also does, after running to some distance. The young are at first covered with a brown-grey down, and drag their steps on the ground, but they are soon enabled to run, and to skulk among tufts of grass, &c. The flesh of the mature birds is rather black, tough, and unsavoury, but that of the young is eatable, and both it and the eggs are reckoned delicious by the Faroe islanders.

7. ARDEA.—Bill straight, pointed, long, somewhat compressed, with a furrow from the nostrils to the tip; nostrils linear; tongue sharp; feet four-toed, cleft, toes connected at the base.

8. *Ardea Virgo*, *Numidian crane*, *Demoiselle heron*, *Demoiselle of Numidia*, &c.—A tuft of long pendent white feathers behind each eye, bill yellowish, with the base greenish and the tip red; head and tips of the primary quill feathers black; feathers of the breast long and pendulous; body bluish-ash; crown cinereous, head, neck, throat, breast, and legs black. The wind-pipe does not, as in the generality of birds, proceed straight forwards into the lungs, but first enters a cavity in the keel of the breast-bone, for about three inches, when it returns by a bend forwards, and then enters into the chest. This very handsome species is about the size of the common crane, and three feet three inches long. It is found in many parts of Asia and Africa, though most plentifully in Bildulgerid, the ancient Numidia, and about Tripoli. Like its congeners, it subsists on small reptiles and fishes, affecting marshes and rivers. In the Crimea it builds its nest in open plains, chiefly in the vicinity of the salt lakes. The young birds

are brought to market by the Tartars, and are so susceptible of domestication that they subsequently breed in the farm-yards. On account of the elegance of its form, the tractableness of its dispositions and its imitative and gesticulating powers, which did not elude the observation of the ancients, the Numidian crane is often kept in confinement, and trained to dancing and other amusing feats.

9. Fulica.—Bill convex, upper mandible arched over the lower at the edge, lower gibbous near the tip; nostrils oblong, front bald; feet four-toed, and sub-pinnated.

10. *Fulica noevia, Small gallinule*, or *grinette.*—Bill and legs greenish, front saffron, feathers of the head and of the upper parts of the body black, edged with rufous, those of the back edged with white, eye-brows white, wings and tail brown; nine inches and three fourths long. Native of Italy, Germany, &c. Supposed to have the habits of the family of coots; but, though noticed by Gessner, Aldrovandus, Willoughby, &c. its history is still obscure.

For *Fulica atra*, see page 442.

V. With the view of illustrating the Gallinæ, we have fixed on *Meleagris gallipavo, Crax alector*, and *Tetrao Scoticus*.

1. Meleagris, Turkey.—Bill conical, and incurvate; head covered with spongy caruncles; chin with a longitudinal membranaceous caruncle; tail broad and expansile; legs spurred.

2. *Meleagris gallipavo, Turkey cock and hen.*—Front and chin carunculated; breast of the male tufted, female without a spur. The female has smaller wattles than the male, and is incapable of erecting the feathers of the tail. In its wild or original state, this well-known bird is black above and beneath, and glossed with violet and gold, measuring about three feet and a half in length, and weighing from twenty even to sixty pounds. In consequence of domestication, it diminishes in size, but acquires a greater diversity of colouring. Though with us denominated *Turkey*, it is an unequivocal native of America, occurring from the country of the Ilinois to the isthmus of Panama, and braving the protracted rigours of a Canadian winter. In summer these fowls occupy the woods in small groups, which occasionally unite into larger bodies of a hundred or two hundred individuals, which quit their retreats and approach near the inhabited parts of the country. They run swiftly, but fly awkwardly; and, about the month of March, they get so fat as to be easily run down by a man on horseback. Being much hunted, they gradually recede from the progress of population. For some time, however, like most of the gallinaceous fowls of North America, they are not easily scared by the sight of man, or the noise of a fowling-piece, whereas the first of them that perceives a bird of prey, even at a distance, utters a call of alarm, when all instantly squat close on the ground. About day-break they send forth their grating and vociferous clamour, which lasts for an hour before sun-rise. They then alight from the trees to go in quest of wild berries, acorns, mast, &c. or to search for insect food. The cocks, among themselves, are fierce and quarrelsome; but, otherwise, they evince little courage. As one suffices for several females, their conflicts often originate in jealousy. The conqueror struts with inflated breast, expanded tail, red face, and relaxed frontal caruncle, making a singular inward noise, which seems to agitate his whole frame. The hen, on the contrary, is of a more mild and timid disposition, so as even, at times, to shrink from protecting her brood from danger. In spring she lays from about fourteen to eighteen eggs, of a white ground, freckled with reddish or yellow, consigning them to some secret spot, as the male is apt to destroy them. She sits with great assiduity and perseverance. The domesticated turkey, though much reduced in size, has a more delicate flavour than the wild one; and the fattest and best for the table are bred in Norfolk. From that county, they are driven to the London market, in flocks of several hundreds, the attendants managing them with great ease, by means of a bit of red cloth tied to the end of a long stick, and which, from the natural antipathy which these birds manifest to red, effectually answers the purpose of a scourge.

3. Crax, Hocco, or Curassow.—Bill strong and thick, the base of each mandible covered with a cere; nostrils in the middle of the cere; feathers of the head turned spirally forward; tail large, straight, and expansile.

4. *Crax alector, Indian cock*, or *Crested curassow.*—*Male*, Cere yellow, body black, belly white; bill black, or corneous; cere reaching from the middle of the bill behind the eyes; crest erect, black, and three inches long; tail black and roundish, composed of fourteen feathers, and eleven inches long. *Female*, Red; head bluish; crest white, tipt with black; bill cinereous; irides red; legs brown. But the markings are subject to much variety; and hybrids are produced by casual intermixture with congenerous species. The crested curassows have greatly multiplied in the immense forests of Guiana; but they are also met with in Brazil, and in the other warm countries of America. They are familiar and slow-paced birds, of heavy flight, and utter a hollow cry, as if the sound were confined within their body. They live on wild fruits and grains, herd in small flocks, and roost, during the night, on lofty trees. Their eggs, which are deposited in the season of the rains, from two to six, according to the breeder's age, are pure white, and of the size of those of the turkey. The flesh of this species is much relished by the planters; and the birds may be easily tamed, and will readily consort with other poultry; but the moisture of our meadows induces a rotting of the toes, which often proves fatal.

5. Tetrao.—Near the eyes, a spot, which is either naked or papillous, or rarely covered with feathers.

6. *Tetrao Scoticus, Red grous*, or *Moor-cock.*—Transversely streaked with rufous and blackish; six outer tail-feathers, blackish on each side; small caruncle on the eye-brows, lunated and scarlet, greater quill feathers brown, tail feathers sixteen, of which the four in the middle are the colour of the back, and the others blackish. This species, so familiar to many of our readers, occurs in extensive uncultivated wastes overgrown with heath, particularly in the most mountainous districts, having been driven from

the south by cultivation. It still haunts some of the mountains of Wales, and the moorlands of Yorkshire and the north of England; but it is no where more plentiful than in the Highlands of Scotland, and in the moors of North Britain in general. It is likewise found in the Hebrides, and among the hills and bogs of Ireland; but seems to be unknown on the continent of Europe. It had even eluded the perspicacity of Linné, whose editor, Gmelin, gives it as a variety of the ptarmigan, to which it at least bears a very close affinity. The red grous never resorts to woods, but limits its range to the upper moors, feeding on the mountain and bog berries, and, in default of these, on the tops of the heath. The sexes pair in the spring, and the female lays from eight to fourteen eggs, much like those of the black grous but smaller. The young associate with the parent birds till towards winter, and are called a *pack* or *brood.* In November, they congregate in greater numbers, sometimes to the amount of thirty or forty; and they are then very shy and difficult to be shot.

VI. That we may not extend this article beyond its due bounds, we shall limit our exemplifications of the wide spread families of the Linnean PASSERES, to *Colomba domestica, Alauda arvensis, Ampelis garrulus, Loxia chloris, Fringilla domestica,* and *Caprimulgus Europœus.*

1. COLUMBA, PIGEON.—Bill straight, descending towards the tip; nostrils oblong, and half covered with a soft tumid membrane.

2. *Columba domestica, Domestic pigeon.*—Cinereous, rump white, band on the wings and tip of the tail blackish. The varieties are, however, very numerous, and not readily reducible to distinct descriptions. Among some of the more prominent, we may notice the *white-rumped* or *smaller rock pigeon,* of a smaller size than the common sort, and varying in its colouring; the *Roman,* of diversified hues, with the cere whitish; the *rough-footed,* with hairy feathers on the legs; the *crested,* also with feathery feet and a crest on the head; the *Norwegian,* with the head crested, the feet feathered, and the body snowy-white; the *Barbary,* with a naked tuberculated space round the eyes, and a double dusky spot on the wings; the *Jacobine,* with the occipital feathers erected; the *laced,* with small erected feathers scattered over the back and wings; the *turbit,* with recurved breast feathers; the *shaker,* with an erect, open tail, of many feathers; the *tumbler,* so called from turning over in its flight; the *helmet,* with the head, quill, and tail-feathers of one colour, and the rest varied; the *Persian* or *Turkish,* with a papillated red cere; the *carrier* or *messenger,* with a carunculated white cere, and the palpebrae naked; the *pouter,* with the breast inflated; the *horseman,* with inflated breast and carunculated cere; the *smiler,* which turns over in its flight, and makes a loud noise with its wings; the *turner,* with the feathers on the back of the neck reversed; and the *spot,* having the body white, with a frontal spot of the same colour as the tail. Unreclaimed individuals of the present species have two broods in the year, and lay their eggs in nests, rudely constructed in the holes of rocks, or of deserted towers. In domestic confinement, however, they will breed from three even to twelve times in the course of the year, according to circumstances. They seldom lay more than two eggs at a time; and they incubate for about fifteen days. They are notorious for the quantity of grain which they devour, and celebrated for their pairing attachment and fidelity. In disposition they are gentle and timid; and being esteemed a delicate food, they have been generally domesticated. Both in ancient and in modern times, the carrier variety has been trained to carry intelligence, with rapidity, from considerable distances.

3. ALAUDA, LARK.—Bill cylindrical, subulate, straight, the mandibles equal, and a little gaping at the base; tongue bifid; hind claw straight, and lower than the toe.

4. *Alauda arvensis, Field,* or *Sky-lark.*—Outer webs of the two middle tail feathers white, inner side ferruginous, upper parts of the body varied with blackish, reddish grey, and whitish, under parts reddish white; bill and legs black, throat spotted with black. A variety sometimes occurs which is wholly white, another which is cream-colour, another of a black-brown hue, and a fourth, which has been observed in Russia, has been remarked for the length of its legs. The present well known species, which may be readily discriminated from its congeners by the length of its tail, is about seven inches long, nearly a foot in stretch of wing, and weighs an ounce and a half. The male is somewhat larger and browner than the female, with more white at the tail, and the hinder claw longer. Inhabits Europe, Asia, and Africa; is most common in open, upland, and arable districts, placing its nest on the ground among the grass, corn, clover, or turnips, and forming it of dry grass, and other vegetable stalks, with a lining of fine hay. The eggs, which are generally four or five, are of a greyish ground, spotted with brown. The incubation lasts a fortnight; and two broods are usually produced in the course of the season. When hatched, the mother watches over them with the most tender solicitude and affection. They are at first fed with worms and insects; but, when full grown, they live chiefly on seeds, herbage, and various vegetable substances. They are easily tamed, and become so familiar as to eat off the table, and even to alight on the hand. The field lark is tuneful in spring and summer, his song being chiefly heard in the morning and evening; and he is one of those few birds that chaunt their mellow strains on the wing. He mounts almost perpendicularly, and by successive springs, into the air, hovering at a considerable height, and then descending in an oblique direction, unless menaced by a bird of prey, or attracted by his mate, when he drops down to the ground like a stone. When he first quits the earth, his notes are feeble and interrupted, but, as he rises, they gradually swell to their full tone. In winter these birds are mute, assemble in flocks, get fat, and are captured in multitudes for the table of the epicure.

5. AMPELIS, CHATTERER.—Bill straight, convex, somewhat incurved, each mandible notched; nostrils covered with bristles; tongue sharp, cartilaginous, and bifid; middle toe connected to the outermost at the base.

6. *Ampelis garrulus, Waxen, Bohemian,* or *Silk-tail chatterer.*—Hind head crested, secondary quill-feathers tipt with red horny appendages, bill and legs black, irides bright ruby, cheeks tawny, throat black, with a small bristly tuft in the middle; head and body reddish ash above; ocular line and chin black; breast and belly, pale purplish-bay; lesser wing-coverts brown, greater, remotest from the body, black, tipt with white; quill-feathers black, the three first tipt with white; tail black, tipt with yellow. Length eight inches; size nearly that of a starling. Inhabits Europe, Northern Asia, and America; occasionally visits this island in flocks, frequenting the neighbourhood of Edinburgh in February, and picking the berries of the mountain-ash. In vine countries, it is very partial to grapes. Its flesh is reckoned excellent.

One of those rare birds, the silk-tail chatterer, (*Ampelis garrulus,*) was lately (1825) caught in the neighbourhood of Melville. This is one of the most beautiful of our occasional visitants from the arctic circle, and has been seen in Britain only at long intervals. The present one corresponded very exactly with Bewick's description, and had on each wing six of those flat vermilion-coloured horny appendages, which form so peculiar a characteristic of the bird. When caught it appeared much exhausted, and on being put into a dark cage ate a few of the haws of the evergreen thorn, rejecting the seeds; but died in the course of the night."

7. Loxia, Grossbeak.—Bill strong, thick, convex, and rounded at the base, lower mandible bent in at the edge; nostrils small; round at the base of the bill; tongue truncated.

8. *Loxia Chloris, Green grossbeak, Green-finch, Green-linnet.*—Yellowish green, primary quill-feathers edged with yellow; four lateral tail-feathers pale yellow at the base; bill brownish; legs flesh-coloured. The female is brown, with the parts that are yellow in the male olivaceous. A white or *albino* variety sometimes occurs. The green grossbeak is rather larger than the house-sparrow, its length being six inches and a-half, expanse of wing nine inches, and weight nearly eight drachms. Inhabits Europe and Kamtschatka, and is not uncommon in various parts of this country, in summer frequenting woods, orchards, and gardens, or haunting the highways, feeding on seeds and grain, but becoming gregarious in winter, and associating with chaffinches and yellow-hammers. During severe cold it migrates from particular districts, and it is rather a late breeder. The nest is composed of small dry twigs, bents, and moss, interwoven with wool, and lined with hair and feathers, placed in some hedge or low bush, or among ivy that surrounds a tree. The female lays from four to six greenish-white eggs, with detached spots of brown and purple. She sits very closely, while the male is very attentive in fetching her food. This species readily intermingles with the canary. Its own song is far from interesting, but being of a docile and familiar disposition, it will catch the notes of other birds, and may be taught to perform various little feats. When much exposed to the solar rays, it is apt to become blind.

9. Fringilla, Finch.—Bill conical, straight, and pointed.

10. *Fringilla domestica, House-finch,* or *House-sparrow.*—Quill and tail-feathers brown, body grey and black; wings with a single white band; bill black; crown of the head grey; a black spot under each eye, a broad bay mark on the hind-part of the head; cheeks white, chin and under-side of the neck black, edged with white; lesser wing-coverts bright bay, and the last row black, tipt with white. The ordinary weight of the male is about seven drachms, its length nearly six inches, and its extent of wing eight inches eight lines. The female is a little smaller, wants the black patch on the throat, and is plainer and duller in her whole plumage. The most remarkable varieties are, 1. white; 2. yellow, clouded with chesnut above; and, 3. blackish. The house-sparrow has been so denominated because it is seldom found remote from the habitations of man; and many of them are so besmoked in our towns and cities, that their native markings are scarcely traceable. They are found to be stationary in Europe, Asia, and Africa, supporting alike the heat of Egypt and the cold of Siberia, though in the latter country not advancing beyond the line of cultivated crops. Buffon and others have eloquently deplored their extensive depredations on our fields and gardens; but honest Bradley reminds us, by palpable experiments, that they are also great devourers of insects and their larvæ, insomuch that, if their extermination could be effected, it might be attended with more injury than benefit to the cultivators of the soil. Though familiar with the haunts of human society, they are not easily snared in summer; but in autumn, and especially in winter, when they congregate, and often collect in great numbers on trees, they may be taken with a bat-fowl net. Their flight is short and laborious, and they will rise abruptly with noise and in a flurry, but seldom to any considerable elevation. Like the wren and tit-mouse, they secure a roosting retreat for the winter. The males are very ardent in courtship, and fight obstinately for the possession of their mates. The female constructs her nest in the hole of a wall, in thatch, under the eaves or gutters of a house, or in the nest of a martin or other bird, and not unfrequently in the bottom of that of a rook. In some of these cases it is rather carelessly made up of hay and feathers, but, when regularly built on the top of a tree, it is usually as large as a man's head, with a cover to keep off the rain, the whole principally composed of hay and straw, warmly lined with feathers, fragments of thread or worsted, bits of cloth, &c. Should the nest be destroyed, another is reared in 24 hours.—The female usually breeds thrice in the year, each hatch consisting of from four to six or eight greenish-white eggs, thickly dotted with dusky and cinereous. The house-sparrow is readily domesticated, and has been known to attain to 18 years, when it exhibited all the symptoms of old age. In some parts of the continent the young are cocked for the table.

11. Caprimulgus, Goatsucker.—Bill slightly curved, very small, subulate, depressed at the base, gape extremely wide, and furnished at the sides with a series of bristles; ears very large; tongue pointed and entire; tail unforked, of ten feathers; legs short; middle claw with a broad serrated edge.

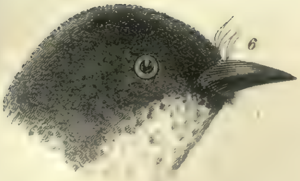
12. *Caprimulgus Europœus,* or *European Noctur-*

*nal goatsucker.*—Black, varied with cinereous, brown, ferruginous and white above, reddish white, with brown bands beneath; irides hazel; legs short, scaly and feathered below the knees. The male is distinguished from the female by a large oval white spot, near the end of the first three quill-feathers, and by another on the outermost tail-feathers. Length fully ten inches, expanse of wing one foot nine inches, and weight between two and three ounces. Native of Europe, Asia, and Africa. In this island it is found, though in no great plenty, from Cornwall to the county of Ross, but only as a summer visitant, appearing about the middle of May, and departing late in August or early in September, but never in flocks. They perch lengthwise on a bough, and not, like most other birds, in a cross direction. Though partial to woods and their outskirts, they likewise affect stony and heathy districts. Like owls, they are seldom seen in the day-time; but, in the dusk of the evening, they prey with activity on the larger nocturnal insects. When perched, they utter a jarring note, and when on wing a loud buzzing noise, which has been compared to that of a spinning-wheel. On some occasions they repeat, four or five times in succession, a plaintive note or squeak, which has been supposed to be the call of the male. Their wheeling movements are so rapid and abrupt, that they generally elude the aim of the sportsman. "There is no bird," says Mr White, "whose manners I have studied more than those of the *caprimulgus,* (the goatsucker,) as it is a wonderful and curious creature; but I have always found, that though sometimes it may chatter as it flies, as I know it does, yet in general it utters its jarring note sitting on a bough; and I have for many an half hour watched it as it sat with its under mandible quivering, and particularly this summer. It perches usually on a bare twig, with its head lower than its tail. This bird is most punctual in beginning its song exactly at the close of day; so exactly that I have known it strike up, more than once or twice, just at the report of the *Portsmouth* evening gun, which we can hear when the weather is still. It appears to me past all doubt, that its notes are formed by organic impulse, by the powers of the parts of its windpipe, formed for sounds, just as cats pur. You will credit me, I hope, when I assure you, that, as my neighbours were assembled in an hermitage, on the side of a steep hill, where we drink tea, one of these churn-owls came and settled on the cross of that little straw edifice, and began to chatter, and continued his note for many minutes; and we were all struck with wonder, to find that the organs of that little animal, when put in motion, gave a sensible vibration to the whole building." These birds make no formal nest; the female depositing two or three dull white eggs, spotted with brown, in a hole, on the ground, or among brakes. They have this name from the ancient but erroneous notion of their sucking the teats of the goat. They have also various provincial appellations, as, ***night*** or ***dorr-hawk, churn-owl, goat*** or ***fern-owl, wheel-bird, night jar,*** &c.

## EXPLANATION *of the* PLATES, *and of the* TECHNICAL TERMS *in Ornithology made use of by* LINNÆUS *and other Ornithologists, descriptive of particular parts peculiar to some Species.*

Plate 147.—1. *Cere, Cera,* the naked skin covering the base of the bill in the hawk kind.—2. *Capistrum,* a term expressive of the short feathers on the forehead just above the bill. In crows, these fall forward over the nostrils.—3. *Lorum,* The space between the bill and the eye generally covered with feathers; in some birds naked, as in the black and white grebe.—4. *Orbita,* the skin that surrounds the eye, which is generally bare, particularly in the heron and parrot.—5. *Emarginated* applies to a bill that has a small notch near the end, as that of the butcher-bird and thrush.—6. *Vibrissæ pectinatæ,* stiff hairs that grow on each side of the mouth, formed like a double comb, as in the goat-sucker, fly-catcher, and others.—7. *Alula spuria,* bastard-wing, a small joint rising at the end of the middle part of the wing, or the cubitus, on which are three or five feathers.—8. Lesser wing-coverts, *tectrices primæ,* the small feathers that lie in several rows on the bones of the wings, the under coverts of those that lie inside of the wings.—9. Greater coverts, *tectrices secundæ,* feathers that lie immediately over the quill-feathers and the secondaries.—10. Quill feathers, *primores,* the largest feathers of the wings, or those that rise from the first bone.—11. Secondary feathers, *secondariæ,* those that rise from the second bone.—12. Coverts of the tail, *uropygium,* those that cover the base of the tail.—13. Vent-feathers, *crissum,* those that lie from the vent to the tail.14 —Tail-feathers, *rectrices.*—15. Scapular feathers, those that rise from the shoulders, and cover the sides of the back.—16. *Nucha,* the hind part of the head.—17. *Rrostrum sabulatum,* sabulated, or awl-shaped, applies to a bill straight and slender, in the form of an awl.—18. *Pes ambulatorius,* all the toes divided to the bottom.—19. *Pes grassorius,* the outer toe more or less united to the middle one, as in the feet of the kingfisher.—20. *Pes scansorius,* formed for climbing, like the foot of the woodpecker.—21. *Pes lobatus,* finned, or lobed, like those of the grebes.—22. Scallopped feet, *pes pinnatus,* the webs indented in the sides, as in coots and sand-pipers.—23. *Pes tridactylus vel cursorius,* wanting the back toe.—24. *Pes didactylus,* composed of only two toes, as in the ostrich.—25. *Pes semi-palmatus,* semi palmated, when the webs reach only half way to the toes.—26. *Ungue postico sessili,* when the hind leg adheres to the leg without any toe, as in the petrels.—27. *Digitis quatuor omnibus palmatis,* all the four toes connected by webs, as in the corvorant.—28. *Rostrum cultratum,* when the edges of the bill are very sharp, as in that of the crow.—29. *Unguiculatum,* a bill with a nail at the end, as those of ducks and goosanders.—30. *Lingua*

# ORNITHOLOGY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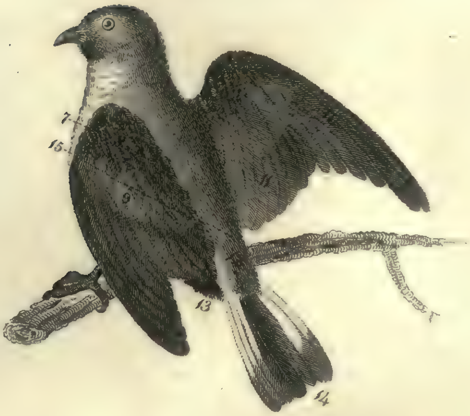

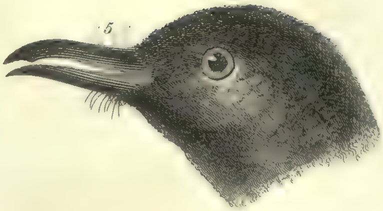
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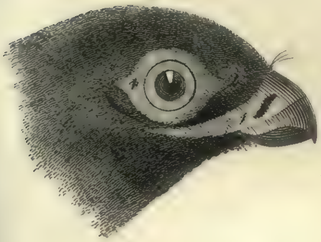

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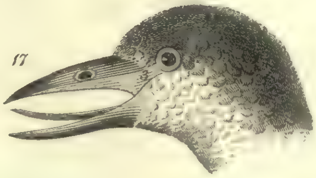

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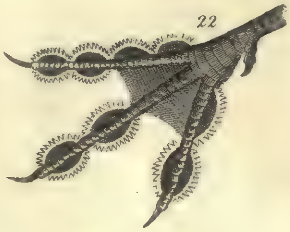

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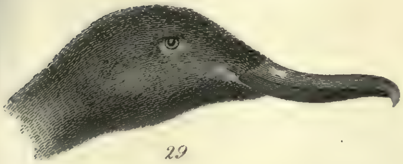
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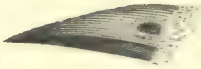

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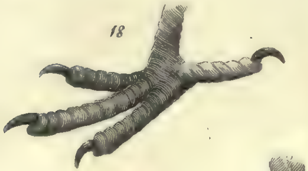

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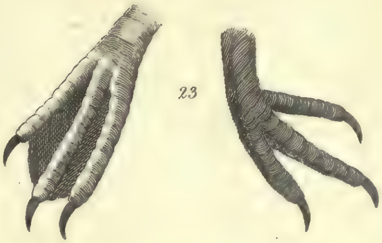

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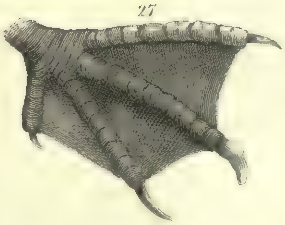

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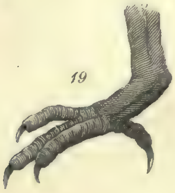

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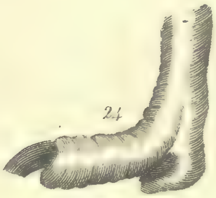

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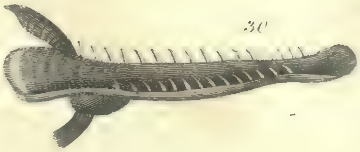

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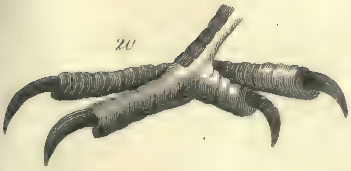

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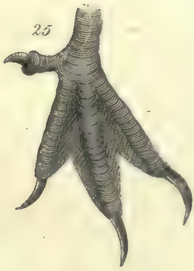

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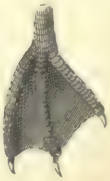

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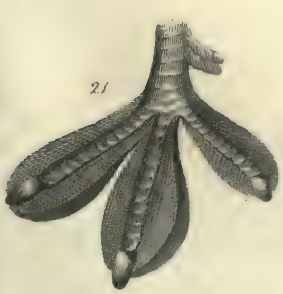

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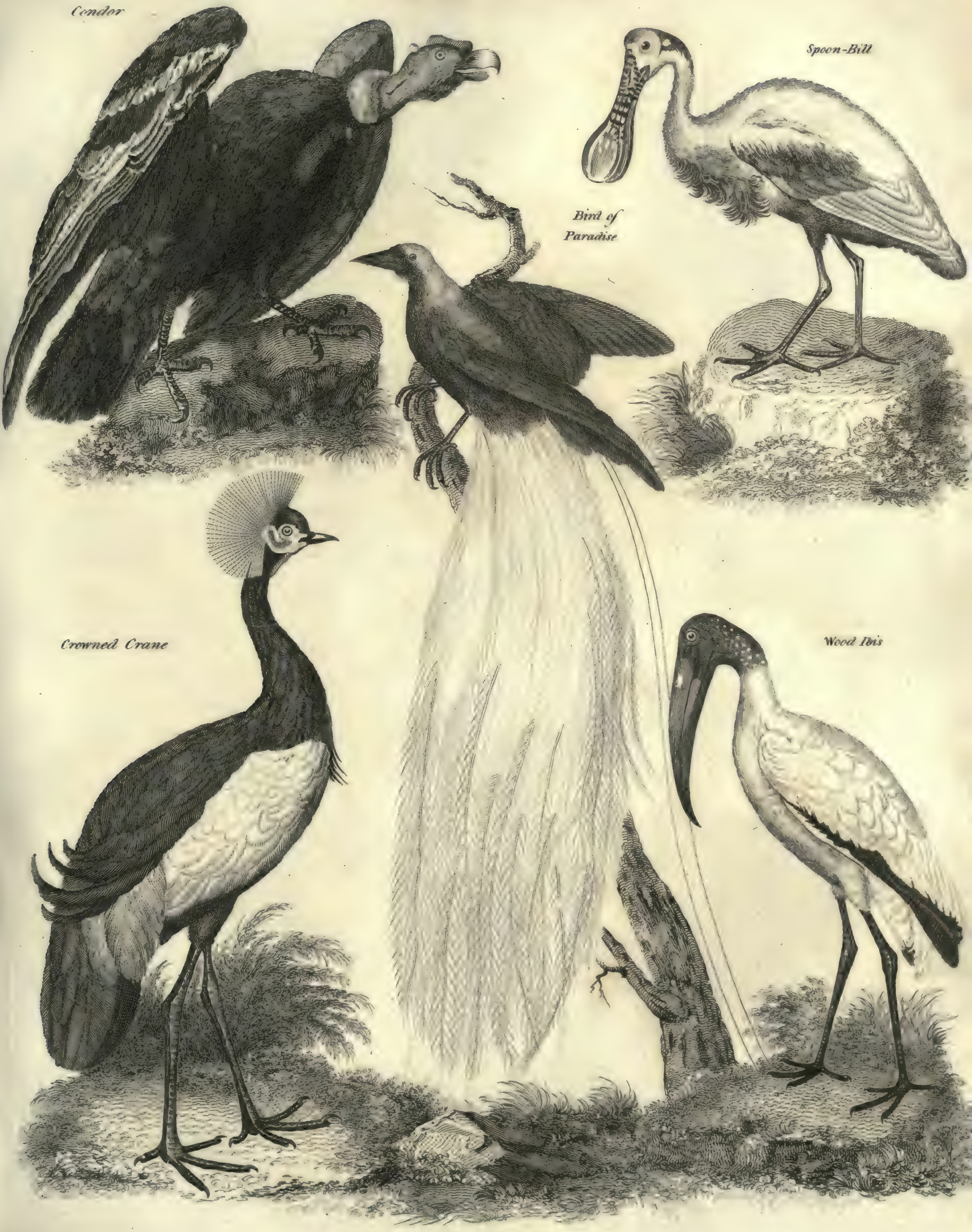
# ORNITHOLOGY PLATE 148



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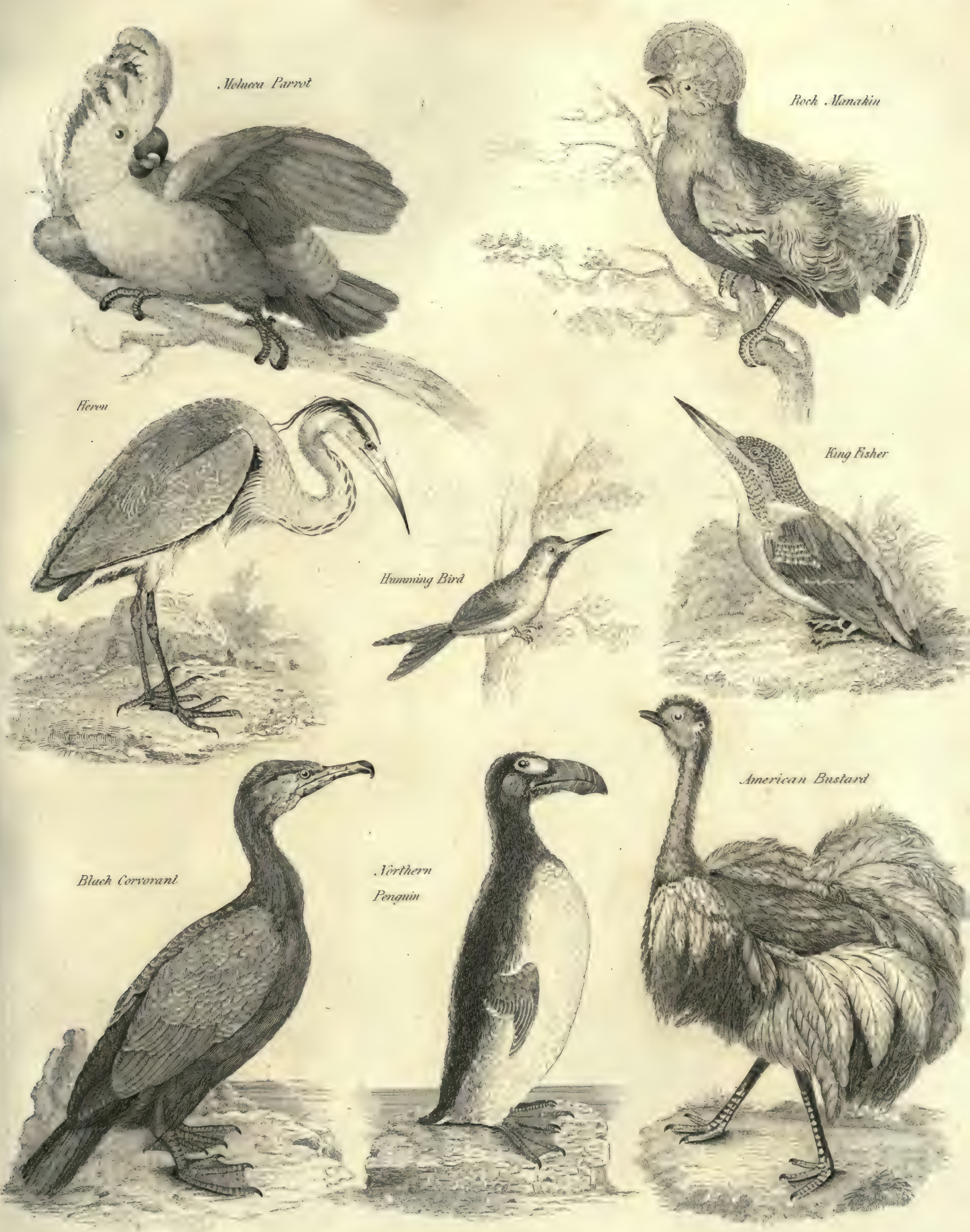
# ORNITHOLOGY

PLATE 149



Engraved for the Encyclopaedia Edinensis by W. Miller

*ciliata*, when the tongue is edged with fine bristles, as in ducks.—31. *Integra*, when plain or even.—32. *Lubriciformis*, when the tongue is long, round, and slender like a worm, as that of the woodpecker.—*Pedes compedes*, when the legs are placed so far behind as to make the bird walk with difficulty, or as if in fetters, as in the auks, grebes, and divers.—33. *Nares lineares*, when the nostrils are very narrow, as in sea-gulls.—34. *Emarginatæ*, with a rein round the nostrils, as in the stare.—*Iris*, that part that surrounds the pupil of the eye.—*Mandibles* denote the upper and under parts of the bill.—*Compressed*, vertically flattened.—*Depressed*, horizontally flattened.—*Caruncula*, a fleshy excrescence on the head.—*Hypochondria*, the hinder sides of the breast and abdomen.—*Ocellated*, with roundish concentric spots of different colours.—*Phalanges*, the articulations of the toes.

Plate 148. contains the Condor, the Spoon-bill, the Bird of Paradise, Crowned Crane, and Wood Ibis.

Plate 149. contains the Molucca Parrot, the Rock-Manakin, the Heron, the Humming-bird, the King-fisher, the Black Corvorant, the Northern Penguin, and the American Bustard.

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OROBUS, bitter vetch, a genus of plants belonging to the Diadelphia class.

OROONOKO, or ORINOCO, a rapid and tortuous river of South America. See AMERICA, and likewise *Hydrography* under GEOLOGY.

ORPHEUS, the famous ancient poet and musician, is said to have allured the Argonauts, in their grand expedition, to row by the sound of his lyre. But whether he was a real or an imaginary personage has been doubted; and Dr Cudworth, in his *Intellectual System*, maintains, from a passage in Cicero, that the accounts of him are merely allegorical.

ORRERY, a piece of machinery designed to represent the motions of the heavenly bodies, and hence more properly called Planetarium. See PLANETARIUM.

OSIRIS, one of the divinities of ancient Egypt. See APIS and EGYPT.

OSNABURG, or OSNABRUCK, a city of the kingdom of Hanover. See HANOVER.

OSSIAN, the far-famed Celtic poet, and son of Fingal the renowned king of Morven, is now generally supposed to have flourished about the close of the third, or the commencement of the fourth century. In early life he married Everallin, daughter of Branno, king of Lego in Ireland; but she died soon after the birth of their only son Oscar, whose exploits he commemorates in his poems, and whose death he mourns in the first book of Temora. He does not appear to have married a second time, and though it is not known at what age he died, it is more than probable, from the contrasts he makes in his poems, that he lived to a great age. When by the weight of years, and the consequent loss of his eyesight, he was rendered incapable of wielding the spear, he mitigated his woes by contemplating the daring exploits of his warlike career. Ossian had several brothers, whose deeds of valour he celebrates in glowing terms; but he himself outlived all his family and companions, excepting Malvina, his son Oscar's wife, to whom he addresses most of his poems, or rather history. In the romantic Glen-Almond, situated to the north of Crieff in Perthshire, there is a tomb called Ossian's, and which is supposed to be such by the natives, who enthusiastically cherish the memory of the bard; yet that his remains were indeed deposited in that situation, is not a little doubtful. The honour of giving birth to Ossian has been claimed by Ireland as well as by Scotland. His name however is as familiar to the ear of every Highlander as Homer was to the Greeks, and Horace or Virgil to the Romans, while the warlike deeds or feats of strength of Fingal and his heroes have, in traditionary story, attached unfading celebrity to the Highlands and islands of Scotland.

The poems of Ossian, as translated by Mr Macpherson, have been the subject of a great deal of controversy; and not only has the authenticity of these sublime compositions been called in question, but some have even doubted the reality of Ossian himself. To the noble and indefatigable exertions of the translator, however, every lover of taste is indebted for the preservation of these poems, which have assuredly come down to us in a mutilated condition. (See MACPHERSON.) More than half a century has now elapsed since their publication, and during that period the question of their authenticity has been keenly discussed; and entirely opposite views of the subject have appeared in different works. The publication of Mr Malcolm Laing's Dissertation on Ossian's Poems, appended to his History of Scotland, which appeared in 1800, seemed at first not a little calculated to bias the public mind in discrediting the authenticity of the poems, as the objections of that ingenious author were couched in apparently cogent terms. Our limits will not permit us to enter minutely into this very interesting controversy; but we must in particular notice one important point, which has been replied to in a most satisfactory manner by the writer of the article Ossian in the Edinburgh Encyclopædia. One of the main objections urged by Mr Laing is, the want of internal evidence of the ancient date of the poems, and of unequivocal proof that they were indeed copied from ancient manuscripts, or collected from tradition. Indeed, the authenticity of these poems before that gentleman had agitated the subject, rested chiefly on the fact that compositions by the immortal bard Ossian, similar in all the leading features to those given to the public as translations by Mr Macpherson, did really exist in the Highlands; but the proof in confirmation of this point Mr Laing views as deplorably deficient, whence he arrives at the conclusion, that *negative evidence with respect to the authenticity becomes positive evidence with respect to the forgery of the poems.* This formidable objection is, however, ably refuted by the Reverend Dr Irvine of Little Dunkeld. "Is it possible," says he, "to believe, without almost a miracle of imposture, that such bodies as the Highland Societies of London and Scotland, composed of English, Irish, Scots, and Caledonians, Germans, Danes, and French, could, during a period of 60 years, have lent their aid to a daring unprecedented adventure, and to the present hour persist in their delusion! Is the unbelief of a few individuals of questionable motives, or no motives at all, to be weighed against such external evidence? If these learned and honourable bodies had made no inquiry to procure satisfaction respecting the credit due to these poems, or to Mr Macpherson, there might be some room for discussion; but whoever reads the Report of the Highland Society of Scotland, and the edition of Ossian's Poems by the Highland Society of London, with the admirable dissertation, by Sir John Sinclair, accompanying that edition, will at once see that they were most anxious to afford all the evidence in their power,—evidence which completely satisfied themselves, and ought in reason to satisfy others. Here we may remark, that Cesarotti, and all other foreigners, wonder how the question as to the authenticity of these poems should ever have been agitated. They had no common feeling with Caledonians. They judged of the poems themselves as presented in a hurried translation. They saw every mark of antiquity and originality, such as no modern poet ever produced. Dante, Petrarch, Camoens, Voltaire, and many others were before them, and in comparison fell to nothing. They saw that, without a new and unaccountable phenomenon in human nature, it was utterly impossible that Mr Macpherson could in so short a time have produced poems in all their bearings so unlike every other modern composition."-See Cesarotti's *Diss. Oss.* Vol. III. and also Baron Edmund de Harold's Poems, ed. 1787, Dusseldorf.

The testimony of Mr Hill, who, it is generally known, made a journey through the Highlands during the summer of 1780, for the purpose of making inquiries respecting the authenticity of the poems in question, is, we conceive, more than equivalent to any thing we might presume to advance on the subject. On reviewing the following candid observations by that gentleman, the individual must certainly be sadly blinded by prejudice who will not yield to the fair impression they are calculated to enforce. But, indeed, from the very peculiarities of style and manner in the different compositions translated and published by Macpherson, as well as by Smith, the idea of imposition on the part of these literati seems altogether sceptical, and unworthy of countenance; and it may further be remarked, that in the numerous papers left by Mr Macpherson, there appears no trace whatever of his having either composed the poems, or desired it to be supposed he had. See *Gentleman's Magazine,* Vol. liii.

"From this collection," says Mr Hill, "it is evident that there are many traditional songs preserved in the Highlands relating to Fingal and his heroes, as well as to several other subjects. It is also evident, that these songs contain portions of the very poems published by Mr Macpherson and Mr (since Dr) Smith, under the name of Ossian. We may therefore justly conclude, that these poems are not wholly the forgery of their editors, but compiled at least from original songs. I by no means think it worth my while to notice the various concessions, in favour of this conclusion, which the minor antagonists of Ossian have of late been forced to make. I myself have given proofs of it, which need I hope no external confirmation. To these proofs might be added, that I met with many traditional preservers of these songs in different parts of the Highlands: some of them, especially in Argyleshire, Lochaber, and on the rest of the western coast, were said to possess various poems attributed to Ossian, although I had neither leisure nor opportunity to collect copies of them. But enough has already been said on this subject, if my testimony deserves regard. These principles being established, it remains to be considered how far the poems published by Macpherson and Smith deserve to be considered as the works of Ossian. The songs attributed to that bard, which contain passages of the Ossian of Macpherson and Smith, are by no means uniformly consistent with the poems in which the parallel passages are found, but frequently relate to different events, and even contain different circumstances. From hence it seems most probable that Mr Macpherson and Mr Smith compiled their publications from those parts of the Highland songs which they most approved, combining them into such forms as, according to their ideas, were most excellent, and preserving the old names and the leading events. In this process they were supported and encouraged by the variety of songs preserved in the Highlands upon the same subject, and by the various modes in which the same event is related. Mr Macpherson may indeed have manuscripts of all the poems he has published, which manuscripts may either have been compiled by himself or by some former collector; or they may possibly contain entire poems really ancient. But Mr Smith has honestly acknowledged that he himself compiled his Ossian in the manner above described. "After the materials were collected," says he, "the next labour was to compare the different editions; to strike off several parts that were manifestly spurious; to bring together some episodes that appeared to have a relation to one another, though repeated separately; and to restore to their proper places some incidents that seemed to have run from one poem to another: and hence it was unavoidably necessary to throw in sometimes a few lines or sentences to join some of the episodes together. I am sensible that the form of these poems is considerably altered from what is found in any one of the editions from which they are compiled. They have assumed somewhat more of the appearance of regularity and art than that bold and irregular manner in which they are originally delivered." He likewise speaks of the Ossian of Macpherson in a similar manner: "That we have not the whole of the poems of Ossian, or even of the collection translated by Mr Macpherson, we allow; yet still we have many of them, and of almost all a part. The building is not entire, but we have still the grand ruins of it."

What portion, therefore, of the Ossian of Macpherson and Smith is original, no man can determine except themselves. Smith indeed says, that he has mentioned all his material alterations, transpositions, and additions, in his notes; and that for the most part he was guided in them by the Sgeulachds, or traditionary tales, accompanying the songs:—but there are few such notes in his book, and perhaps as few such Sgeulachds in the mouths of the Highlanders. In Macpherson and Smith also we see these poems divested of their idiomatic peculiarities and fabulous ornaments, which renders it impossible to discover what manners and opinions are really ancient, and what are of modern invention. Yet it is remarkable, that in spite of all the objections to their anthenticity, necessarily produced by such a treatment of them, they still possess an internal evidence of originality which has enabled them hitherto to withstand all the torrent of opposition.

Though it is undeniable that Mr Macpherson has not succeeded in avoiding every thing of a modern air in his translation, it is yet certain that he anxiously exerted himself as much as possible to do so, as appears from a letter of his own, written in the year 1792, as well as from various other papers. We cannot here refrain quoting the opinion of the celebrated Dr Blair, in reference to the necessary liberties used by Mr Macpherson, especially as it accords perfectly with what has been said above. In a letter to Mr Morrison, he thus decidedly expresses himself: "That Mr Macpherson may not have given an exact and scrupulous translation of all these poems; that he may have joined and collected scattered pieces into one, and have omitted some rudenesses that were in the original, is what I never called in question. But that they are not poems of his composing, but are really and truly in the substance of them genuine original and ancient Gaelic songs, well known to many natives of the Highlands, is what, from numerous circumstances, which I had access to trace, I am as fully convinced, and as certain of, as I can be of any thing under the sun."

It may be remarked, in conclusion, that the poems published by Macpherson and Smith are evidently not all Ossian's, though the utmost care has been taken to preserve them free from all spurious compositions. The different poets are strikingly indicated by certain peculiarities. Thus, in Macpherson's collection, Cath-Loda appears to be in the manner of Ossian, while Carrickthura is in that of Ullin. Not only is the style of Ossian readily distinguished by the discriminating reader from that of Ullin, the poet-laureate, Fergus, Carrul, Cronan, Minonn, and others, but it is also easily discernible from that of many poets whose compositions have been preserved for two or three hundred years back,

OSTEND, a maritime town of the Netherlands; is well built, and strongly fortified, and has a tolerably good harbour. By means of canals, it is connected with Bruges and Ghent on the west, and with Nieuport on the east; and a packet conveys the mail to and from Dover. The population in 1815 was 10,800.

OSTIA, an ancient town of Campagna di Roma, in Italy, which was built near the mouth of the Tiber, by Ancus Martius, the fourth king of Rome. Though the see of a bishop it is now in a decayed state, having never recovered from the destruction brought upon it by the Saracens.

OSTRACISM, from the Greek, signifying *a shell,* was a term used to denote the billet on which the Athenians wrote the names of persons of merit and influence who were destined to be banished, lest any attempts should by them be made against the public liberty. The billet itself was a piece of baked earth in form of a shell. The first victim to the punishment of ostracism was the individual who suggested it, but the ancients differ respecting the time of its establishment.

OSWESTRY, a market town of Shropshire, in England, which is rapidly extending beyond its ancient boundaries, and possesses a considerable trade in cotton, linen, and woollen stuffs. Besides the church, it contains several chapels, and a free grammar school. Population, 3,910. This town was once encompassed with strong walls, and had a castle, some fragments of which yet exist.

OTAHEITE, or TAITI, one of the islands of the Pacific ocean, situated between 17° 28′ and 17′ 53′ south latitude, and between 149° 10′ and 149° 40′ west longitude from Greenwich, and consisting of two peninsulas, joined by an isthmus, the breadth of which is about three miles, while the whole circumference of the island is upwards of 40 miles.

*Aspect.*—This island, the aspect of which is very pleasing, is encompassed by a reef of coral rocks, and likewise by a border of low land of about a mile in depth. It is mountainous, more especially in the centre, where it is intersected by numerous valleys opening from the coast, and where the rivers are supplied with water by means of innumerable mountain streams, which add much to the beauty of the scenery, as they fall in agreeable cascades. Viewed from the sea, the coast is elevated in the manner of an amphitheatre; and, at the distance of three miles from the beach, the country rises into considerable elevations, luxuriantly covered with woods. The climate is, in general, remarkably healthful and serene; but between the months of December and March, the weather is rainy and squally. A considerable lake in one of the inland districts, contains eels of enormous dimensions, and is so very deep that the natives assert it cannot be sounded.

*Natural History.*—Otaheite appears to have had a volcanic origin, as the stones everywhere bear evidence of having undergone the action of fire. The soil of the low maritime land and of the valleys is exceedingly fertile, being a rich black mould; but that of the elevated tracts consists of various veins of red, white, dark, and bluish earth. A great variety of the most excellent vegetable productions, especially bread-fruit, bananas of different sorts, cocoa-nuts, plantains, yams, potatoes, ginger, sugar-canes, and Indian corn; together with grapes, pine-apples, and other fruits, are, with little or no culture, produced in abundance. The precious yellow and dark-coloured sandal-wood grows in some of the higher regions, and yields the perfume for cocoa-nut oil, wherewith the natives anoint themselves. Even the summits of the highest mountains are in some places covered with bamboos, and different sorts of trees. The inhabitants of Otaheite discover much fondness for the various beautiful flowers, shrubs, and trees, with which the island is adorned. Of the shrub trees, the most remarkable are the Chinese paper mulberry, or cloth plant, the bark of which, when steeped, is manufactured into white cloth; the yava, from whose root is expressed the only intoxicating beverage of the country; the wild sloe tree, from the bark of which is made a fine grey cloth; the prickly palm, the silk cotton shrub, the cabbage tree, and the wharra, which affords fruit not unlike the pine apple. Besides these and other productions which are carefully cultivated, tobacco is abundant throughout the island, and hemp, hops, red pepper, and liquorice are likewise produced.

The hogs of Otaheite are of great size, and remarkably numerous; and the dogs are generally used for food. Goats, though plentiful, are entirely disregarded; cows have been introduced, but without advantage, as they are allowed to run wild in the mountains; but the breed of sheep now appears to thrive. Cats are greatly increased in numbers, but rats swarm over the country, and occasion considerable damage, the natives being scrupulous of destroying them. The domestic poultry, similar to those of Europe, are very much esteemed in Otaheite; and there are abundance of wild ducks, doves, herons, paroquets, woodpeckers, tropic birds, and many others. Fish constitutes the principal luxury of the Otaheitans, who are much employed in catching them, by means of nets of all sizes, hooks, and lines, and also three-pronged spears, which latter are employed to dart at such as come into shallow water. Musquitoes, scorpions, and a considerable variety of other insects, together with lizards, are troublesome to the natives, who are also much infested with that intolerable vermin fleas.

*Government.*—In the island of Otaheite the government is monarchical, and the heir-apparent is, even from his birth, acknowledged as sovereign. The king and queen are honoured by being carried about on men's shoulders; and they are usually saluted by all ranks in the same manner, namely, uncovering the head, breast, and shoulders. A regal authority is maintained by the chiefs in their particular districts, and the lower classes are bound to do service to them, though by no means in a slavish capacity. Even though deprived of his property, a chief continues noble, while none of the people can be elevated to a higher rank than that of a gentleman, or the towha of a chief. Though tradition and land-marks afford the only testimony regarding property, encroachments, it is said, very seldom occur on the rights of each other. It is worthy of remark, likewise, that an avaricious disposition is almost unknown among the Otaheitans, who rarely have individual quarrels, and who consider want of due respect the only just ground of serious offence.

*Population.*—By Captain Cook the population of this island was estimated at 100,000; by the first missionaries, at 15,000; latterly, by Turnbull, at 5000. To the frequency of their wars, the practice of infanticide, and of human sacrifice, as well as to the prevalence of disease arising from the luxurious habits of the people, has been attributed this dreadful decrease of the inhabitants. But it is gratifying to know that, in consequence of the meritorious exertions of missionaries in civilizing these interesting islanders, the causes now alluded to at length cease to threaten the extinction of their race; and similar changes have been likewise happily effected in the other islands of the Pacific ocean.

*Peculiarities and habits.*—The Otaheitans are of a pale-brown complexion, with black eyes, flat nose, large mouth, fine white teeth, and black frizzled hair; and they are stout, well-made, of good stature, and cheerful disposition. The women are generally less in size than the men, and are finely formed, though rather of a masculine figure. It is an established practice with these islanders to puncture the skin, and stain it, by communicating a dark colour into the wounds; and, like the Chinese, they wear long nails on the fingers as a mark of distinction. The men wrap a piece of cloth round about their middle, and another round the head, like a turban, while the dress adopted by the females is a piece of cloth, having a hole in the middle, through which to admit the head, and hanging down to the knees; and over this a fine white cloth, passing in different elegant turns, one of which generally falls in a graceful manner across the shoulders. These people inhabit huts with scarcely any walls, as they consist principally of a roof thatched with leaves and raised on a few pillars. In such dwellings, however, with a layer of leaves for their bed, they are generally very healthy, vigorous, and long lived. From the salubrity of their climate, and the simplicity of their diet, they are exempted from almost all dangerous maladies; but they are sometimes liable to a sort of leprous disorder, to cholic and coughs, and such persons as fare sumptuously are afflicted with a sort of gout. In restoring the sick to health, it is usual, in Otaheite, for the exorcist, first, to pronounce a particular set of words, and then to apply the leaves of the cocoa-tree plaited to the fingers and toes of the individual, and thus leave nature to combat with the disease, unassisted with any favourable application of art. Besides vegetables, these islanders subsist on fish, poultry, and pork. They feed voraciously, having no regular system of meals, and the women eat in separate apartments, where the servants of the family are accustomed to sleep. Their furniture consists of a few wooden-trays and stools, wooden-pillows, a chest of large size, and a matting or cloth which is spread on the floor to serve as bedding. In their habits the chiefs, in particular, are extremely luxurious; and from the daily use of the intoxicating liquor produced from the yava, they have generally a white scurf on the skin, which, by some of the common people, is fancifully supposed a mark of nobility.

*Employments and amusements.*—The natives employ themselves almost as much in amusement as in labour. As the cultivation of the soil does not demand much attention, their principal occupations are the manufacture of cloth, the making of canoes, domestic utensils, and arms. They fabricate cloth of the bark of different trees, by forming it into a paste, and beating it out with grooved beetles on smooth beams. Considerable taste is evinced in the formation of their canoes, which are of different sizes, and some of them qualified to carry about 300 persons; and they also finish their cloth-beetles, fishing implements, bows, arrows, &c. in an elegant manner. In climbing trees, swimming, diving, and such-like exercises, they are remarkably nimble; and they are expert in wrestling, throwing spears of great length at a mark, and in shooting with the bow and arrow. Such adepts are they in the use of the sling, that they are capable of throwing a stone with such force as to sink it into the bark of a tree at the distance of 200 yards. The Otaheitans have various dances, which are usually performed by the men and women, and consist of slow regular movements of the hands and feet, according to the music; and among their other favourite amusements may be mentioned singing and pantomime, in which latter the libidinous chiefs are not unfrequently the objects of satire.

*Customs.*—Many strange customs and ceremonies have been practised by the natives of Otaheite. The women, besides their being obliged to take their meals apart from the men, were denied the use of particular kinds of food; and if a man happened to touch their provisions, which were always gathered by themselves, they were in consequence thrown away. No female was permitted to touch any thing of a sacred nature, or to enter the morais or places of worship. On the celebration of marriage, an instrument was usually given to the woman, having a shark's tooth inserted into the end of it, and also a lancet, wherewith, on every occasion of joy or grief, she was to wound her head till the blood flowed copiously. Of the master of a house, the tayo, or chosen friend, familiarly enjoyed all his privileges, but was on no account whatever to have communication with any other of the family. It is remarkable that, even in the persons of the chiefs, old age was treated with neglect or contempt, while, from the moment of his entering into existence, the first male child who succeeded to the honours of the family was held in the highest respect. Indeed, the children were absurdly indulged in all things from their infancy, and treated even as the heads of the families. Infanticide was formerly prevalent, and female infants, particularly, were destroyed, to avoid the care and trouble of rearing them. The natives of this island have been accustomed to eradicate every hair from the nose, arm-pits, and other parts of the body, and to anoint themselves with fragrant oils. They are careful to adjust their eye-brows and eye-lashes, and to trim their beard and hair; and so prone are they to cleanliness, that even disease does not prevent them from bathing, if possible, three times every day in fresh water. In approaching the chiefs, or the sacred places, they used to uncover the head, breast, and shoulders, while equals commonly saluted each other by touching noses. Almost nothing could more provoke a native than to lay the hand upon his head, or compare the size of any thing to it; and the head being thus considered so very sacred, nothing was ever to be carried upon it.

*Religion, &c.*—In their general manners the Otaheitans are peculiarly generous and affable to each other, though in their wars they used to be barbarous in the extreme. Possessing a powerful command of their feelings, they are consummate flatterers, and to obtain their object they will exert every art of insinuation and cunning. They have generally a soft and harmonious voice; their language, which resembles that of New Zealand and the Friendly islands, is free from every harsh or guttural sound; and they are likewise adepts in the art of expressing themselves by signs. In their idolatrous religion, no dread of punishment in a future state of existence was inculcated, but rather the prospect of different degrees of happiness according to their merits in the present life. Of the various deities formerly worshipped by them under the designation of *Eatooa*, three were conceived to be supreme, and were therefore addressed only in cases of extreme emergency; but every island had its particular divinity, while every family had its guardian spirit, which was supposed to be the blessed manes of some deceased relative. Their worship consisted in prayers, offerings, and even human sacrifices on very solemn occasions. The priests formed a numerous body, who pretended to be familiar with the mind of the *Eatooa*, to foretel events from omens, and to be capable of curing diseases, which, according to their doctrines, were punishments from the gods for offences committed. By means of the rapid progress of civilization, however, these idolatries have been renounced, and the practices of infanticide, human sacrifices, and sanguinary wars have been almost entirely discontinued.

Otaheite was discovered by Captain Wallis in 1767, and called by him George the Third island. In the following year it was visited by Captain Cook, for the purpose of there observing the transit of Venus, and it was afterwards twice visited by that great navigator. See Cook's *Voyages*, Wilson's *Missionary Voyage*, Turnbull's *Voyage round the World*, and *Reports of the London Missionary Society*.

OTLEY, a market-town seated on the river Wharf in the West-Riding of Yorkshire, is well built, and consists of four handsome streets. It contains a spacious church, wherein are several ancient monuments; and likewise a well endowed free-school. The population is estimated at 3000. The environs of this town present to the eye a variety of fine scenery, enlivened with numerous gentlemen's seats.

OTRANTO, or Terra d'Otranto, a province of Naples, bounded on the north by Terra de Bari, and on all other sides by the sea, is a mountainous country, productive of olives, figs, and wine, and extending about 70 miles in length and 30 in breadth.

*Otranto*, the capital, seated at the entrance of the gulph of Venice, is an archbishop's see, and a place of some trade, with a convenient harbour and a strong citadel. It is distant 140 miles south-east from Bari.

OTTORY, or OTTERY, ST MARY, a market-town of Devonshire in England, situated near the river Otter, is tolerably well built, and contains a spacious church, which is very ancient, and similar to a cathedral. It has extensive manufactures of woollen stuffs, and the population exceeds 3500.

OTWAY, THOMAS, an English dramatic poet of considerable eminence, was born at Trotton in the county of Sussex in 1651, and educated at Wykeham school near Winchester. In 1669 he became a commoner of Christ church, Oxford; but subsequent to the death of his father, who was rector of Woolbeding, he unadvisedly quitted college, with the view of devoting himself to the stage. After having tried his abilities for the histrionic profession, with very little success, he commenced his career as a tragic poet. His *Alcibiades* appeared in 1675, when also was performed his *Don Carlos, Prince of Spain*; and so happily received was this latter piece, that the author acquired not only literary repute but also needful emolument. Being thus raised from a state of indigence and brought into public notice, Otway was erelong introduced to the Earl of Plymouth, a natural son of Charles II. by whose influence he obtained a commission in a regiment then newly raised, and destined for Flanders. But notwithstanding this propitious change of fortune, he was not long after involved in pecuniary distress, by means of his imprudent habits of indulgence; and having quitted the army, he was again obliged to exert himself for a subsistence in the composition of tragic poetry. The *Orphan* was composed by him in 1680, and two years afterwards appeared his *Venice Preserved*. Both of these tragedies were remarkably successful; yet so embarrassed were the circumstances of the ingenious Otway, that he was at that period compelled to take refuge in a house in Towerhill, where he died in a state of poverty in 1685, at the early age of 34 years. Of his death, Dr Johnson gives the following account: "He died in a manner which I am unwilling to mention. Having been compelled by his necessities to contract debts, and hunted, as is supposed, by terriers of the law, he retired to a public house, on Tower-Hill, where he died of want, or, as it is related by one of his biographers, by swallowing, after a long fast, a piece of bread which charity had supplied. He went out, as is reported, almost naked, in the rage of hunger, and finding a gentleman in a neighbouring coffee-house, asked him for a shilling. The gentleman gave him a guinea; and Otway going away, bought a roll, and was choaked with the first mouthful. All this, I hope, is not true; but that indigence, and its concomitant sorrow and despondency, brought him to the grave, has never been denied." Pope was informed that Otway died of a fever brought on by too active pursuit of a thief who had robbed one of his friends. Of the nine dramatic pieces written by this celebrated but most unfortunate character, the *Orphan* and *Venice Preserved* are decidedly the best and most generally admired. Otway was likewise author of a number of miscellaneous poems.

OUDENARDE, or AUDENARDE, a fortified town of the Netherlands, divided into two parts by the Scheldt, is a manufacturing place, with a population of 5000, and contains many excellent buildings, among which are two parish churches.

OUGHTRED, WILLIAM, a celebrated mathematician, born at Eton in 1573, was educated at his native place, and afterwards elected to King's college, Cambridge, which he quitted in 1603, when he had attained holy orders, and likewise a presentment to the rectory of Aldbury, near Guildford in Surry. Such were his mathematical powers, that pupils from all quarters sought his instruction, and the most eminent scholars of his time courted his correspondence. He was characterised as "facetious in Greek and Latin, solid in arithmetic, geometry, and the sphere of all measures, music, &c.; exact in his style as in his judgment." The works of Oughtred were, Clavis Mathematica; a Description of the Double Horizontal Dial; Opuscula Mathematica, and some others. He died in the 88th year of his age.

OVID, PUBLIUS OVIDIUS NASO, a distinguished Latin poet, born at Sulmo, B. C. 43, was designed by his father for the bar, with a view to which he successfully prosecuted the study of rhetoric; but so strong was his predilection for gaiety and the muses, that he could not apply himself seriously to business. Among the admirers of his lively genius, were Virgil, Propertius, Tibullus, and Horace, and he was even honoured with the patronage of Augustus, till, by some criminal act, he incurred the displeasure of that emperor, and was in consequence banished to Tomos, a city on the Euxine sea, where he died at the age of 59. Of the works of this celebrated poet, the greater part still remains; and the best editions are those of Heinsius, Elzevir, 1629; Burman's, Amst. 1727; Wetstein's, Amst. 1751; Barbou's, Paris, 1762, and Fischers, Lips. 1773.

OVIEDO, the capital of the province of Asturias, in Spain, seated at the conflux of the Ove and Nora, which rivers fall into the Nalon. It is a bishop's see, with a university, and contains a population of 6400. Manufactures are established of hides, horn combs, and hats.

OUNDLE, a market town of the county of Northampton in England, seated on the river Nen, over which there are two bridges; is neatly built, and contains a free grammar school, a guild or hospital, and an alms-house. Population of the parish 2150.

OURFA, formerly EDESSA, a town of Asiatic Turkey, which is the seat of a considerable inland trade, as the caravans from Aleppo pass through it in journeying to the interior provinces of Persia. It is the capital of the pachalic of the same name, which forms great part of ancient Mesopotamia. Ourfa contains 20,000 inhabitants, consisting of Arabs, Turks, Americans, Jews, and Nestorians.

OUSE, a river of Sussex, formed by two streams, which rise, the one in St Leonard's forest, the other in that of Worth; it then passes by Lewis, and falls into the Channel below Newhaven, where it forms a good harbour at its mouth.

OUSE, a river of Yorkshire, formed by the conflux of the Ure and the Swale, four miles below Boroughbridge; after which it passes by Aldborough, York, Selby, &c. and after receiving the Wharf from the N.W. the Derwent from the N.E. the Aire from the W. the Don from the S.W. joins the Trent on the borders of Lincolnshire, where the united streams form the Humber, 17 miles W. of Hull.

OUSE, a river of Canada, which runs into Lake Erie, in Lon. 79° 30′ W. Lat. 42° 50′ N.

OUSE, Greater, a river of England, which rises near Fitwell in Oxfordshire, and proceeds to Buckingham, Stony-Stratford, and Newport-Pagnel, in Buckinghamshire; from thence it proceeds to Bedford, and turning north-east it passes on to Huntingdon and Ely, till at length it arrives at Lynn-Regis in Norfolk, and falls into the sea. It is navigable to some distance above Downham, where there is a good harbour for barges; and a considerable trade is carried on by it to Lynn and other towns. It is sometimes liable to great floods.

OUSE, Lesser, rises in Suffolk, and separating that county from Norfolk on the S.W. runs into the Greater Ouse, near Downham.

OUTLAWRY, the punishment inflicted for contemptuously refusing to be amenable to the process of the higher courts of law. By outlawry, in civil actions, the person forfeits all his goods and chattels to the king, and the profits of his land, while the outlawry remains in force; but in treason or felony, he not only forfeits all lands or tenements held in fee or for life, but his absence is interpreted as full evidence of guilt, on which ensues corruption of blood, when he may perish without law. The killing an outlaw is, however, now declared murder, except it be in the attempt to apprehend him. In civil suits, outlawry is usually had recourse to where an action is brought against two partners, one of which being abroad must be outlawed before the other be proceeded against; and if the defendent afterwards appear publicly, he must be committed by a writ of *capias utlagatum*, till the outlawry be reversed; which reversal may be had by his appearing in court, or in the King's Bench, by sending an attorney, according to statute 4 and 5 W. and M. cap. 18. because the outlawry being merely a process to enforce appearance, any plausible circumstance may reverse it.

OWEN, John, a nonconformist divine of considerable eminence, was born at Haddenham, in Oxfordshire, in 1616, and died at Ealing in 1683. Having prosecuted his studies at Queen's college, Oxford, he was made master of arts in 1635; but was, not long after, obliged to quit the university, because he could not comply with certain new regulations instituted by Archbishop Laud. About the time of the civil war, he repaired to London, where he united himself with the Nonconformists, and laid the foundation of his fame in 1642, by publishing his "Display of Arminianism." He subsequently embraced the principles of the Independents, and likewise became a favourite of Cromwell, whom he accompanied on a visit to Ireland, and who afterwards sent him to Scotland for a short period. In 1651, he obtained the deanery of Christ Church, Oxford, was nominated vice-chancellor, and was created doctor of divinity by diploma; but on the death of Cromwell he lost the vice-chancellorship, and at the Restoration was removed from the deanery, when he retired to his estate at Haddenham. Dr Owen was equally respected for his learning and moderation. His works consist of seven volumes folio.

OWHYHEE, the largest and most easterly of the Sandwich islands in the Pacific ocean, lies in 154° 45′ west longitude, and 19° north latitude, and, being of a triangular form, is at at the utmost 97 miles in length, and 78 in breadth. It has a rugged and mountainous aspect, and consists of six divisions, with a population estimated at 150,000. Mouna Kaah and Mouna Roa, the two loftiest mountains, are covered with snow, and elevated to the height of more than 16,000 feet above the level of the sea; and to the north the coast presents high and abrupt cliffs, down which fall a number of beautiful cascades. The southern portion of the island is extremely dreary, appearing to have undergone a total change from the effects of some great convulsion of nature; and the projecting headland of the same quarter consists of broken and craggy rocks irregularly piled one upon another. The coast of Apoona, however, on the south-east is level and beautiful, while the acclivity of the inland parts is gentle; and indeed the greater portion of the island is very rich and well cultivated. Among the chief productions are bread-fruit, and cocoa-nut trees, plantains, yams, sugar-canes, and the tarrow or eddy root. The plantations are extensive, and the fields are inclosed by stone fences, and interspersed with groves of trees; but there being no cattle on the island, none of the soil is laid out in pasture. Fish is very plentifully obtained from the neighbouring sea, and constitutes a principal article of food in addition to the vegetable produce; and with people of rank the flesh of the wild boar and of dogs is esteemed peculiarly delicious.

The natives of this island have agreeable features, and are of an olive brown complexion. They are stout, active, and above the middle size, and have their bodies tatooed, and their nose generally spread at the point. In their persons they are remarkably cleanly, and the clothing of both sexes is nearly similar, being a piece of cloth, which by the women is worn loosely like a wrapper, but by the men is passed between the legs and fastened to the loins. Both men and women are fond of ornaments of various kinds. Devoid of the grossness and ignorance which are characteristic of the savage life, the Owhyheans are a superior race of people. They are of an inquisitive turn of mind, and not without some traits of civilization; and in agriculture and manufactures they are said to have made considerable progress. Human victims, it is true, are still sacrificed by them, yet they do not eat the flesh of these victims as the inhabitants of the neighbouring islands do. It is hoped that, through the benevolent exertions of missionaries, these interesting people will, by the introduction of a knowledge of the gospel among them, improve erelong in refinement, and all the blessings of civilized society. In this island the system of government is monarchical; and next to that of royalty there are three degrees of rank, which are sopposed to be hereditary. Of the towns, or rather villages of Owhyhee, none is situated farther from the shore than about four or five miles, and the most considerable are Kirooah and Kakooa. From a sudden impulse of unmerited resentment, Captain Cook lost his life in this island in 1779. We have already stated the circumstance, in the account given of his life. Captain Vancouver, during his stay here, introduced the art of ship-building, which will probably contribute very much to the prosperity of the island, as it enjoys considerable advantages for commerce. In 1810 the king of Owhyhee had reduced almost all the Sandwich islands under his dominion. See the *Voyages* of Cook, Vancouver, La Perouse, and the Missionary Voyage conducted by Captain Wilson.

OXFORD, the capital of a county, and seat of a university of the same name, in England, is pleasantly situated at the conflux of the rivers Isis and Cherwell, and at the distance of rather more than 50 miles from London. It is an ancient, celebrated, and magnificent city, with a population of 14,900; is the see of a bishop; and consists of thirteen parishes. The name Oxford is from good authorities supposed to be a corruption of *Ouseneyford*, the ford at or near Ouseney, or the meadow of Ouse, the term *Ouse* denoting a water. Such is the antiquity of Oxford, that some have dated its origin so very early as 2954 or 1009 years B. C. and Lhwyd observes, "It is indeed unknown what names Oxford hath borne, on account of its great antiquity." The city is governed by a mayor, high steward, recorder, alderman, &c. and the mayor, who is chosen annually, the principal citizens, and the sheriff of the county, are by oath bound to maintain the interests of the university. To each of the parishes of Oxford there is a proper church; and the most remarkable of these edifices are, the church of St Peter in the East, built about the year 876, that of St Giles, built about the commencement of the twelfth century, and those of St Ebbe's, St Martins, and All Saints. This admirable city has two principal streets; the High street, which, from its singular formation, is unusually attractive, and the street of St Giles's, consisting chiefly of private houses. Among the other public buildings may be noticed the Ashmolean museum, the Clarendon printing-house, so named from its having been erected partly with the proceeds arising to the university from the sale of Lord Clarendon's *History*; the theatre, the infirmary, and the observatory.

*University.*—The university, which is of very great antiquity, together with the various edifices connected with its colleges, adds materially to the importance and celebrity of this city. King Alfred, who is understood to have resided in Oxford, was undoubtedly a liberal benefactor of its seminaries of learning. The statutes of the university are contained in a volume, entitled, *Corpus Statutorum Universitatis Oxoniensis*, and in the British museum is preserved the copy of these statutes, printed on vellum, which was presented to Charles I. In this university the principal officers are, the chancellor, lord high-steward, vice-chancellor, two proctors, and an orator. The most important of the libraries are the St Bodleian, All Souls, Christ Church, Queen's, New, John, Corpus Christi, and Exeter. In 1822 the whole population connected with the university was 4295, of which 1956 were members of the convocation.

One of the first regular houses of education in Oxford was University college, said to have been founded by Alfred the Great. Among the eminent characters who have been educated in this university, are the learned Sir William Jones, the present Lord Chancellor of England, his brother, Lord Stowell, the Master of the Rolls, and also Judge Richardson.

Baliol college was founded about the year 1268 by John Baliol, father to the king of Scots, and augmented afterwards by a succession of benefactors.

Merton college, which was founded by Walter de Merton in the reign of Henry III. contains some of the oldest buildings in the university, and the edifice devoted to the library is a good specimen of the architecture of the fourteenth century. In the chapel were interred the remains of Sir Thomas Bodley, founder of the Bodleian library.

Oriel college, of which Edward II., or rather his almoner Adam de Brome, was the founder, is now in a most prosperous state, having no less than 246 members, of whom 122 are members of convocation.

Exeter college had for its founder, in 1314, Walter Stapleton, bishop of Exeter and Lord-treasurer. By subsequent benefactors it was considerably augmented.

Queen's college was founded in 1340 by Robert Eglesfeld, confessor to the consort of Edward III., and was, in 1739, enriched by the bequest of John Michel, Esq. of Richmond. The buildings, which were completed in 1759, are remarkably beautiful; and the college possesses an ancient drinking horn, set in silver, which is said to have been the gift of Philippa, Queen to Edward III.

New college, founded in 1386, by William of Wykeham, bishop of Winchester, and Lord Chancellor of England, is a very magnificent foundation; its chapel is the most splendid in the university; and the gardens, being bounded by a portion of the old city wall, are worthy of notice.

Lincoln college owes its existence to Richard Flemming, bishop of Lincoln, who founded it in 1427. The buildings were, however, greatly enlarged by another bishop of Lincoln, Thomas Rotheram, who also provided a new code of regulations in 1479; and by the generosity of the fellows of the college, its exterior has recently undergone considerable improvement. The chapel contains some fine carving, and some of the best painted glass in Oxford.

All Souls college was, in 1437, founded by Henry Chickley, archbishop of Canterbury, who in the following year obtained a charter from Henry VI. Very little now remains of the old structure; but the modern buildings evince very strikingly the taste and liberality of the society. The library is only surpassed by the Bodleian, and the chapel is magnificent.

Magdalen college, founded in 1456, by William Wainfleet, bishop of Winchester and Lord Chancellor of England, is remarkable for an elegant tower; and being situated at the last entrance to Oxford, has a fine appearance from Magdalen bridge, which is of itself likewise a beautiful object. The new buildings, consisting of three tiers of rooms, were completed in 1733. It is not unworthy of notice here, that the celebrated Mr Addison was a fellow of Magdalen college.

Brazen Nose college had for its founders William Smyth, bishop of Lincoln, and Sir Richard Sutton, knight, and was begun in 1509. This college is indebted for its great celebrity to the munificence of Dr Hodson, regius professor of divinity, and canon of Christ church.

Corpus college was in 1516 founded and endowed by Richard Fox, bishop of Winchester. The library of this college is rich in printed books and manuscripts, in a state of good preservation.

Christ Church college is the most considerable foundation in Oxford. For its erection and endowment two bulls were, in 1524 and 1525, granted by Pope Clement VII. to Cardinal Wolsey, authorising him to suppress certain religious houses, and appropriate their revenues; and the cardinal further received a grant from Henry VIII. of the priory of St Frideswide. By the disgrace of the cardinal in 1530 the college was unfortunately impeded; but after a lapse of two years, it was re-established by the king, and endowed with an yearly income of L.2000, for a dean and twelve canons, which, however, was suppressed in 1545, when the charter was given up. In 1546, the establishment was converted into "The cathedral church of Christ in Oxford of King Henry Eighth's foundation;" a consignment being at same time made to the dean and chapter of all the estates and property, for the maintenance of eight canons, eight chaplains, an organist, eight clerks, and as many choristers; as well as 60 students, 40 grammar scholars, and a schoolmaster and usher. In 1561, Queen Elizabeth caused the 40 grammar scholars to be converted into academical students, and in 1663 one student was added to the number. The whole members in 1822 amounted to 695, of which those belonging to the convocation were 345. A portion of the ancient edifice of St Frideswide is occupied as the cathedral. The great bell, which formerly belonged to Ouseney abbey, is of the enormous weight of 17,000 pounds. In the library, which is a splendid structure, are contained the collections of books made by Archbishop Wake, Lord Orrery, Bishop Fell, Dean Aldrich, &c., together with a collection of pictures, the bequest of General Guise.

Trinity college owes its origin to Sir Thomas Pope, knight, treasurer of the court of augmentation under Henry VIII.

St John's college was founded in 1557 by Sir Thomas White, knight, alderman and lord mayor of London, but was afterwards very much improved by the munificence of successive benefactors, particularly Dr Richard Rawlinson, whose heart is preserved in an urn erected in the chapel. This college possesses a most superb library, and the gardens attached to it are laid out with admirable taste.

Jesus college was, in 1571, founded by Queen Elizabeth, in consequence of the petition of Hugh Price, who also contributed lands and money for the purpose. It has been improved by subsequent benefactors.

Wadham college, was founded by Nicholas and Dorothy Wadham in 1613, at an expense of L.15,816, 7s. 8d., as appears from a note-book preserved in the college. The buildings are remarkably splendid, and the chapel, library, and gardens are worthy of notice.

Pembroke college was converted from Broadgate-Hall, in 1620, by Thomas Tesdale, Esq. and Richard Wightwick, and subsequently augmented by different benefactors.

Worcester college, formerly Gloucester-Hall, was founded by Sir Thomas Cookes, Bart. at the commencement of the last century, and has been augmented by Dr Finney, Dr Clarke, and Mrs Sarah Eaton.

There are five halls, besides the colleges, namely, St Mary Hall, St Mary Magdalen Hall, St Alban Hall, Edmund Hall, and New Inn Hall. These houses are appropriated for the education and residence of students, but are not endowed with estates.

OXFORDSHIRE, a county of England, bounded on the north by the counties of Northampton and Warwick, on the west by Gloucestershire, on the south by Berkshire, and on the east by Buckinghamshire; is of an irregular form, extending at the utmost about 50 miles from north to south, and from 7 to 38 miles from east to west. It contains an area of 474,880 acres, and is divided into 207 parishes. This county, which has been celebrated for its extensive forests, is well watered, extremely fertile, and beautifully diversified, more especially in the central parts. In the south-east quarter, the continuation of the Chiltern hills, which are well wooded, adds very much to the beauty of the scenery; but the northern district presents a hilly and barren aspect. The most considerable rivers of Oxfordshire are, the Isis, which takes its rise in Wiltshire, and, flowing southward in conjunction with other rivers, terminates in the Thames; the Charwell, which has its origin in Northamptonshire, and unites with the Isis at Oxford; and likewise the Thame Windrush, Evenlode, Glym, and Ray. Besides the advantages resulting from the various streams which have their course in this county, the Oxford canal is of great benefit. It originates in Warwickshire, passes Northamptonshire in its course, and proceeds to the capital of the county, where it joins the Isis. The climate and soil of this county are highly favourable, and agriculture has been much improved of late years, though it is not a little impeded from the shortness of the leases. So extensive are the landed properties, that a single estate yields L.20,000 a-year, one L.12,000, and some others from L.7000 down to L.5000. Besides the rearing of corn, potatoes, cabbages, lentils, carrots, rape, and chicory, grazing is also attended to. The produce of butter and cheese is very considerable, and likewise a great many calves are fattened for the supply of the London market. Oxfordshire is not remarkable for mineral productions, though it affords excellent ochre, abundance of slate and limestone, and has a few freestone quarries. The whole population of the county was, in 1821, estimated at 136,971. In 1803, no less than 21.525 of the resident population received parish aid, occasioning an expense of L.103,559, 10s. 6d., while the funds raised was at the rate of 18s. 10$\frac{3}{4}$d. per head on the population. It is calculated that about 5 in the 100 of the resident population belong to the friendly societies, of which there are 69 in the county. Among the chief manufactures in Oxfordshire are blankets, gloves, coarse velvet, polished steel, and malt, which latter is in great quantities sent to the London market.

This county, in comparison of other parts of England, presents few traces of encampments and military stations. The remains of a Roman station are to be seen near Alchester; and of the four Roman roads, which stretched from sea to sea across the island, one evidently passed through the southern part of the county. Some funeral mounds, supposed to be of Roman origin, are to be seen; fragments of tesselated pavement, and likewise different Roman coins, have been discovered.

OYSTER, OSTREA. See CONCHOLOGY and FISHERIES.

OZANAM, JAMES, a French mathematician, born at Boligneux in Bresse, in 1640. At an early age he evinced an extraordinary genius for mathematics, which he chose to study as a profession, though he had been educated with a view to the church. As a teacher, he was eminently successful at Lyons, whence he removed to Paris, and was in 1702 admitted an *eleve* of the Royal academy of Sciences. He died in the 77th year of his age. A number of useful works were written by Ozanam, among which are Practical Geometry, a Mathematical Dictionary, a Course of Mathematics, 5 vols. 8vo. Mathematical and Philosophical Recreations, 4 vols. 8vo. and New Elements of Algebra, a work commended by Leibnitz.

# P

P, the fifteenth letter of the English alphabet, is sounded by the anterior part of the lips, being compressed somewhat more suddenly than in forming the sound of B. Indeed, the letters P and B are so similar in sound, that several nations, especially the Welsh and Germans, continue to pronounce one for the other. The sound of P is lost before *t* or *s*, as in the word *psalms*, *Ptolemaic*, &c. When this consonant stands before *h*, they both together have the sound of *f*, as in physic, philosophy, &c. According to St Jerome, the Hebrews had no P, but the *ph* served them instead; and he observes, that the word *apadno* is the only one in the whole Bible read with a P.

P stands as an abbreviation for *publius*, *pondo*, &c. PA. DIG. for *patricia dignitas*; P.C. for *patres conscripti*; P.R. for *populus Romanus*; PR.S. for *prætoris sententia*; PRS.P. for *præses provinciæ*. Among astronomers, P.M. is commonly used for *post meridiem*, or afternoon, and sometimes for *post mane*, after the morning, that is, after midnight.

P was used as a numeral among the ancients, to denote the same number with the G, viz. 100, and when a dash was added at top, thus, $\bar{P}$, it signified 400,000.

Among physicians, P stands for *pugil*, or the eighth part of a handful; P.Æ. *partes æquales*, or equal parts of the ingredients; P.P. denotes *pulvis patrum*, or Jesuits' bark, in powder; and ppt. *preparatus*, or prepared; P. in the Italian music, stands for *piano*, or softly; and P.P.S. for *pianissimo*, or very softly.

PACE, a measure of five feet in length. Pace in the manege is of three kinds, walk, trot, and gallop, to which may be added amble, because it is natural to some horses.

PACIFIC OCEAN, that immense ocean separating Asia from America. On passing the isthmus of Panama, from north to south, the Spaniards, at the first discovery of this ocean, denominated it the South sea; and the part extending south of the isthmus is sometimes so called. Magellan, when he entered the ocean through the dangerous strait which bears his name, sailed three months and 20 days in a uniform direction to the north-west without discovering land; and in the distress endured in this voyage before discovering the Ladrone islands, he experienced such uninterrupted fine weather, with fair winds, that he gave this ocean the name of Pacific. On one side of the equator it bears the name of the North Pacific ocean, and on the other that of the South Pacific ocean. It is upwards of 10,000 miles in breadth.

PACING, a method of measuring short distances by walking over them, and taking the number of steps. A person of middle stature can, with ease, step about eighteen inches; therefore, to the number of such steps, half their number may be added to ascertain how many feet have been paced. If half the number of steps be ascertained, it will be the distance paced in yards.

PACKET, or PACKET-BOAT, a vessel by which the mail of letters, packets, and expresses are regularly conveyed by sea from one kingdom to another. In this service well-equipped gun-brigs are appointed by government. The mails from Dover to Calais, in time of peace; from Falmouth to Lisbon, Gibraltar, Malta, the West Indies and America; from Harwich to Helvoetsluys, or Gottenburgh and Heligoland; from Weymouth to Guernsey and Jersey; from Parkgate and Holyhead to Dublin; and from Milford to Waterford,—are dispatched by the packet-boats, which are under the direction of the postmaster-general of Great Britain.

PADA, a town of Hindostan in Orixa. See HINDOSTAN.

PADAN ARAM, literally denotes the *Plains of Aram*, or *Syria*, translated Syriae by the Vulgate, and by the Seventy simply Mesopotamia, or Mesopotamia of Syria.

PADDINGTON, a village in Middlesex, west by north of London, to which it lies contiguous, yet in a delightfully rural situation. It contains many beautiful seats, and has a handsome church. A canal passes from Paddington to the Grand Junction canal, six miles above Brentford.

PADDOC, or PADDOC-COURSE, a piece of ground inclosed with pales or a wall, and taken out of a park, for the purpose of exhibiting races with greyhounds. It usually extends a mile in length, and a quarter of a mile in breadth.

PADERBORN, a principality of Germany, in the circle of Westphalia, extending 40 miles in length and 30 at its greatest breadth, and lying north of the duchy of Westphalia and county of Waldeck. Some parts of it afford excellent pasture, and breed abundance of cattle, but it is not very productive of corn. In the middle of the country there are high mountains and mines of iron. Deer and other game are abundant. The Weser, the Biver, the Dimer, the Great Emmer, the Nette, the Alme, the Lippe, and the Pader, are the principal rivers. There are many Protestants in this country, though the predominant religion is the Roman catholic. Charlemagne erected the bishopric towards the end of the eighth century, and Pope Leo in person consecrated the cathedral in 796.

*Paderborn*, the chief town of the principality of the same name, is a large, populous, and well built city, situated 52 miles east south-east of Munster. Paderborn was one of the Hanse-towns, and, till 1604, an imperial city. The university, which was founded in 1592, is under the direction of the Jesuits. The cathedral is a remarkably elegant building. Under the high altar of the cathedral rises the rivulet Pader. The inhabitants of Paderborn subsist chiefly by agriculture and the breeding of cattle. The trade of this city is now inconsiderable. An attempt to introduce Lutheranism into this place was made in 1530; but sixteen of the principal citizens, by whom it had been embraced, were executed, and the rest were compelled to abjure it.

PADSTOW, a sea-port town in Cornwall, with a market on Saturday, a convenient harbour, and some coasting trade. See CORNWALL.

PADUA, a province of Austrian Italy, in the government of Venice, is bounded on the south by Rovigo, on the north by Treviso, on the east by Venice, and on the west by Vicenza and Verona, and contains a superficial area of 860 square miles, with a population of about 300,000. Its general appearance at a distance is that of an extensive forest, the fields being surrounded with rows of trees instead of hedges. The Euganean hills traverse the country, and agreeably diversify the prospect. Some of these hills exhibit basaltic columns not unlike the Giant's Causeway, though on a smaller scale. The Brenta and the Bacchiglione are the chief rivers, and several canals intersect the country, and afford considerable facility to irrigation. On account of its fertility, this province has been not unaptly denominated the garden of Italy. Except in a few places near the salt marshes, the air is mild and salubrious. Padua is productive of corn, hemp, rice, wine, fruits, and silk.

*Padua*, the capital of the department of the same name in the government of Venice, is finely situated in a plain between the rivers Brenta and Bacchiglione, in East Long. 11° 52′ 45″, and North Lat. 45° 24′ 2″. This city is surrounded with a mound and ditch, which are between seven and eight miles in circuit. A great part of the inclosed space, however, is unbuilt, and the population does not exceed 31,000. Padua abounds in public buildings, which, in general, are very splendid; but the streets are narrow, dirty, and ill-paved, and the low porticoes, with which they are bordered on either side, give them a gloomy appearance. Il Salone, or the Townhouse, is an immense hall, decorated with some fresco paintings and the busts and statues of several distinguished characters, among which is an ancient bust of Livy, who was a native of this city. Many valuable paintings enrich the palazzo del Podesta, or palace of the chief magistrate. The palazzo del Capitano, or commandant's palace, is a magnificent edifice. The churches are numerous, but few of them are remarkable as specimens of architecture. The cathedral, which is said to be one of the largest in Italy, is a heavy and inelegant building. There is in the sacristry a good collection of pictures, including one of Petrarch, who was a canon of this church, and who bequeathed to it a part of his library. The church of St Justina, being a fine marble edifice, is admired for its symmetry, and for its sculpture, paintings, and rich Mosaic pavements. It has a large piazza in front, which is encircled by a stream of water brought from the Brenta. The church of Il Santo, or St Antonio, is a large Gothic building, remarkable chiefly for the superb tomb of St Antony, and for its chapel, which is adorned with basso relievos representing the various miracles performed by the saint. The university of Padua, which was founded so early as the eleventh century, was once highly celebrated, and the number of students that flocked to it from all parts of Europe and from different parts of Asia, sometimes, it is said, exceeded 18,000. Its annals are graced by many eminent names, among which are those of Petrarch, Galileo, and Columbus. The university consists of three faculties, viz. mathematics and philosophy, law, and medicine, and the professors are 32 in number. The number of students is generally about 300. Among the other literary institutions in this city is the academy of Sciences, which was formed by the senate of Venice in the last century.

Padua was famous in ancient times for its woollen manufactures, and its wool and woollen stuffs are still esteemed as the best in Italy. Manufactures of silk, ribbons, and leather, are likewise carried on to some extent. The trade, however, is inconsiderable.

This ancient city has been peculiarly distinguished among the cities of Italy. According to Virgil, it was founded by Antenor, who, after the destruction of Troy, conducted a party of his countrymen to this part of Italy. Tacitus informs us, that the Paduans observed annual games in honour of their founder. Mention is made by Livy of a naval victory obtained by them over the Lacedemonian fleet, long before their union with the Romans. After they had submitted to Rome, they were treated, not as a conquered state, but rather as allies. We learn from Strabo, that in those times Padua sometimes furnished 20,000 men to the Roman armies, and numbered among its citizens 500 Roman knights. When Italy was invaded by the Goths and other barbarous nations, this city shared in the general calamity, being taken and plundered, first by Alaric and then by

Attila. In the year 600 it underwent a similar fate from the Lombards, to whom it continued subject till the overthrow of their kingdom by Charlemagne. After having been subject to the French and Germans, Padua obtained its liberty, and assumed a republican form of government. It fell under the sway of the Carrara family in the 14th century, and was, in the 15th, united to the Venetian territory. Padua has been burnt several times; it was thrice desolated by earthquakes and once by the plague.

PAEAN, among the ancient Pagans, was a song chiefly used on occasions of triumph, and in honour of Apollo. Pæan in the ancient poetry is a foot consisting of four syllables, of which there are four kinds, the pæan *primus*, *secundus*, *tertius*, and *quartus*.

PÆDOBAPTISTS, a term derived from the Greek, signifying *child* or *infant*, and *to baptise*. It is applied to all persons who baptise infants, so that the Established church of England, the Presbyterians both in Scotland and England, together with the Independents, are all Pædobaptists. Infant baptism has been the subject of great controversy in the church. See ANABAPTISTS, BAPTISTS, &c.

PÆSTUM, a town of Lucania on the Sinus Pæstinus, now denominated the gulph of Salerno, called Posidonia and Neptunia by the Greeks. Livy informs us, that this town was built by a colony before the first Punic war. The soil in the neighbourhood of this place is productive of roses. The roses of Pæstum, which flourished twice a year, were held in great estimation.

PAGAN, BLAISE FRANCIS, Count of, a distinguished French officer and mathematician, who was a native of Avignon in Provence, and born in 1604. He entered the army at the early age of 12 years, and signalized himself in a variety of engagements. By the loss of his eye-sight he was prevented continuing to serve his country in the field; but he assiduously prosecuted the study of mathematics, as applicable to that important branch of military science fortification, and published several works, the chief of which are Geometrical Theorems, the Theory of the Planets, and Astronomical Tables. He is particularly celebrated for his "Treatise of Fortification," published in 1645; and it is said that whatever improvements have been made since have been chiefly derived from this work, as conclusions from its principles. By Louis XIII., Pagan was always viewed as one of the most adroit and most valiant persons in his kingdom. This great man was remarkable for a prejudice in favour of judicial astrology. His house was the rendezvous of persons illustrious for rank as well as science. He died in 1665 at Paris; and his whole works were collected and published, in 12mo, in the year 1669.

PAGANISM, the religious worship and discipline of Pagans. See IDOLATRY, MYSTERIES, MYTHOLOGY, and POLYTHEISM.

PAGO, an island in the Adriatic, about 50 miles long, and separated by a narrow channel from Morlachia. The climate in this island is intensely hot in summer, and severely cold in winter. Pago is remarkable for a large internal salt-water lake, 15 miles long from south to north. The products of this island are wine and salt in abundance, wool, honey, and salt fish. The salt pits occupy the industry of the greater part of the inhabitants. Some of these pits belong to the government, and others to private individuals. Pago contains many vestiges of ancient habitations. The town is said to have been built, about 300 years ago, by the Venetians. This island being little frequented, its inhabitants are in as barbarous a condition as if they lay at the greatest distance from the sea, and intercourse from more civilized people. It is not a little wonderful, indeed, how men could ever resolve to settle in so wretched a place as Pago, which, it is said, has often been abandoned by its inhabitants. The figure of this island is extremely irregular, its breadth being in no proportion to its length. Almost all the circumference is dismal, without trees or any kind of visible plants or grass. The channel or inward bay of Pago is an extremely dangerous station, and even inaccessible in winter, when the boreal wind blows with such fury that the inhabitants of the town dare not venture out of their houses. In winter the sky always appears cloudy, owing to the thick mist which rises from the repercussion of the waves on the long chain of rough and hollow rocks.

PAGODA, or PAGOD, a name usually applied to the idolatrous temples of the Indians. In general, these temples are square stone buildings, of no great height, and crowned with a cupola. They have no windows, and the light received through the entrance is very inconsiderable. The idol, which is usually of a monstrous shape, and of awkward dimensions, is placed in the darkest and deepest recess of the temple. In some pagodas, there is only a single black polished stone laid upon a round altar, covered with flowers and sandal-wood. The worshippers of these idols prostrate themselves upon the ground, and thus make their salam or salutation with their hands, ejaculating their prayers in silence; and they make offerings, consisting of flowers, rice, pieces of silk and cotton, and sometimes gold and silver.

In the *Asiatic Researches*, there is a paper, by Mr Chambers, containing a very satisfactory account of East Indian temples. The monuments which he describes appear, he says, to be the ruins of some great city, decayed many centuries. "They are situated close to the sea, between Covelong and Sadras, somewhat remote from the high road that leads to the different European settlements; and, when visited in 1776, there was still a native village adjoining to them which retained the ancient name, and in which a number of brahmins resided who seemed perfectly well acquainted with the subjects of most of the sculptures to be seen there. Proceeding on by the foot of a hill, on the side facing the sea, there is a pagoda rising out of the ground, of one solid stone, about 16 or 18 feet high, which seems to have been cut upon the spot, out of a detached rock that has been found of a proper size for that purpose. The top is arched, and the style of architecture according to which it is formed different from any now used in those parts. The hill, which is at first of easy ascent, is in other parts rendered more so by very excellent steps cut out in several places where the communication would be difficult or impracticable without them. A winding stair of this sort leads to a kind of temple cut out of the solid rock, with some figures of idols in high relief upon its walls, very well finished, and perfectly fresh." Mr Chambers conjectures this temple to have been a place of worship, appertaining to a palace, of which there are still some remains. This finishes the objects "on that part of the upper surface of the hill the ascent to which is on the north: but, on descending from thence, you are led round the hill to the opposite side, in which there are steps cut from the bottom to a place near the summit, where is an excavation that seems to have been intended for a place of worship and contains various sculptures of Hindoo deities. The most remarkable of them is a gigantic figure of Vishnou, asleep on a kind of bed, with a huge snake, wound about in many coils, by way of pillow for his head; and these figures, according to the manner of this place, are all of one piece hewn from the body of the rock." About a mile and a half south of the hill, there are other stupendous works, which, according to our author, "consist of two pagodas, of about 30 feet long, by 20 feet wide, and about as many in height, cut out of the solid rock, and each consisting originally of one single stone. Near these also stand an elephant fully as big as life, and a lion much larger than the natural size, but very well executed, each hewn also out of one stone. The great rock above described is at some distance from the sea, perhaps 50 or 100 yards; and in that space the Hindoo village before mentioned stood in 1776: but close to the sea are the remains of a pagoda built of brick, and dedicated to Sib, the greater part of which has evidently been swallowed up by that element; for the door of the innermost apartment, in which the idol is placed, and before which there are two or three spacious courts surrounded with walls, is now washed by the waves, and the pillar used to discover the meridian at the time of founding the pagoda is seen standing at some distance in the sea. In the neighbourhood of this building, there are some detached rocks washed also by the waves, on which there appear sculptures, though now much worn and defaced; and the natives declared, that the more aged people among them remembered to have seen the tops of several pagodas far out in the sea, which, being covered with copper, (probably gilt,) were particularly visible at sun rise, as their shining surface used then to reflect the sun's rays, but that now that effect was no longer produced." On one of the pagodas there is an inscription of a single line, in a character of which the Hindoos are now ignorant, and this inscription Mr Chambers considers an object meriting some attention. He likewise supposes, that the splendid city of which these pagodas appear to be part of the ruins, has been destroyed partly by an earthquake, by which the rock was rent, and partly by an inundation occasioned by this commotion of the earth.

In China, the pagodas are considerable towers, rising frequently to the height of nine stories of more than 20 feet each.

PAGODA, or Paga, the name of a gold and silver coin current in some parts of the East Indies.

PAINTING has been defined the art of representing on a plane surface, by means of lines and colours, the appearances of visible objects, under the various circumstances of form, colour, and light and shadow. The grand object of this art is to convey delight by exciting the pleasure that is derived from the contemplation of whatever is beautiful, by means of the power of imitation. Painting is justly esteemed the first of the imitative arts; it embodies the ideas of the poet, and to the symmetry and expression of the statuary it adds the vivid colours of nature, and the soul expressive glance of the eye. For the history, principles, and practice of this art, see Design.

PAISLEY, a town of Renfrewshire in Scotland, situated on the river White-Cart, which is crossed by three stone bridges, respectively called the Old bridge, the New bridge, and the Abbey bridge. In magnitude and population, it is at the present time the third town in Scotland, though it was formerly of much less consequence. Mr Crawford, who wrote the history of Renfrewshire about the commencement of the eighteenth century, describes Paisley as an inconsiderable place, consisting of one principal street about half a mile in length, with several lanes belonging to it. Since that period, however, its buildings have been greatly improved, and the streets are well paved. Although the houses of Paisley, and those of the suburbs connected with it, are arranged in comparatively few streets, they extend over a tract of ground about two miles in length, from east to west, and nearly seven furlongs in breadth from north to south. The New Town stands on the eastern side of the river White-Cart. The other part of Paisley is not so generally called the Old Town as "The Burgh."

There are three parishes in the town of Paisley, denominated from their respective churches, namely the High church, the Middle church, and the Low church. The public buildings, though numerous, are scarcely worthy of particular notice; nor indeed can Paisley cope, in elegance of appearance, with the other considerable towns of Scotland. Among the public edifices, are five places of worship of the Establishment, one of which is the Gælic chapel. The most remarkable of these is the Abbey church, which, when entire, was a noble structure, consisting of several distinct places of worship. Part of it, being now in good repair, serves as the place of worship to a large country parish called Abbey parish, of which the New Town is considered a part. Various meeting-houses in the town belong to dissenting congregations. About 8500 people may be accommodated in the churches of the establishment, and about 12000 in the other places of worship. The castle of Paisley, founded so recently as 1818, is of a quadrangular form, and is one of the largest and finest buildings of Paisley. It comprehends a court-house, council-chambers, and several offices for different departments of public business; two prisons, one for debtors and the other for criminals, a bridewell, and a chapel; and the whole is appropriated to county as well as burgh uses. The steeple of the former town-house now graces the Cross, near which the markets for butchers meat and fish are situated. A handsome edifice stands opposite to the Cross, and the upper part of it is occupied as a public coffee-room, on the tables of which abound newspapers, reviews, and magazines. Besides the grammar-school and four other burgh schools, there are in the town five schools established by subscription or by mortuaries, various charity schools, and upwards of 40 Sunday ones. The population of Paisley in 1821, was estimated at 28,000. It is reremarkable that, in a town of such extent, water for culinary purposes must be purchased from carts which bring it from a distance. This town has long been celebrated for the manufacture of gauze and fancy muslins, besides which, thread-making and cotton-spinning, and manufactures of ribbons and tape, are carried on to a considerable extent. In the Abbey parish, the bleaching business is much attended to, and in the neighbourhood of Paisley there is a calico printing work. At Lord Glasgow's coal-works copperas has been long manufactured, and the manufacture of alum has been for several years past conducted there on a very extensive scale. The river White-Cart enters Paisley on the south-east, and makes three bold curves in the direction of north-west, after which it flows northward nearly in a direct line, till, on getting clear of the buildings, it again becomes devious. The inhabitants derive material advantages from the communication by water to Port-Glasgow and Greenock, and by means of the great canal they have a communication with the Firth of Forth.

Paisley is a town of great antiquity. Its abbey was founded in 1160 by Walter, Great Steward of Scotland, as a priory for the monks of the order of Clugni. The abbey was, in course of time, raised to the rank of an abbacy; and the lands attached to it were, by Robert II. erected into a regality under the jurisdiction of the abbot. Subsequent to the Reformation, the abbacy was secularized; and in 1588, erected into a temporal lordship, in favour of Lord Claud Hamilton, third son of the Duke de Chatelherault, who was created Lord Paisley. His son James became first Lord Abercorn, and the lordship has since continued in the Abercorn family. Close to the abbey-church is the Earl of Abercorn's burial-place, which Mr Pennant considers "by much the greatest curiosity in Paisley. It is a small vaulted Gothic chapel, without pulpit, pew, or any other ornament whatever, but has the finest echo, perhaps, in the world. When the end-door (the only one it has) is shut, the noise is equal to a loud and very near clap of thunder. If you strike a single note of music, you hear the sound gradually ascending with a great number of repetitions, till it dies away as if at an immense distance, and all the while diffusing itself through the circumambient air. If a good voice sings, or a musical instrument is played upon, the effect is inexpressibly agreeable. The deepest as well as the most acute tones are distinctly reverberated, and these at regular intervals of time. When a musical instrument is sounded, it has the effect of a number of a like size and kind playing in concert." About Paisley there are some vestiges of Roman antiquities.

PALÆSTRA, in Grecian antiquity, a public edifice, where wrestling, running, playing at quoits, and other bodily exercises, were practised. Its length was marked out by stadia, each equal to 125 geometrical paces; and hence the name stadium was applied to the arena on which they ran. The bottom of the Palæstra was covered with dust or gravel, to prevent the youthful combatants from being injured by a fall.

PALATINATE, a province or district possessed by a Palatine, and from which he takes his title and dignity. Different opinions have been entertained respecting the origin of the name Palatine; but very probably it was derived from the *palatia* or palaces which the old Frankish and German kings and Roman emperors were possessed of in different parts of the country, and over which supreme stewards or judges, called palatines or psalzgraves, were by them appointed. From these palatines, the countries where they held their courts were called Palatinates.

PALATINE COUNTIES OF ENGLAND, are the counties of Chester, Durham, and Lancaster,—so called from their having been invested with legal rights and prerogatives. The isle of Ely is sometimes, though erroneously, denominated a county palatine; but it is only a royal franchise, the bishop having, by grant of Henry I., power to exercise, within the isle of Ely, a jurisdiction over all causes, as well criminal as civil.

PALENCIA, a city of Spain, in the province of Leon, with an archbishop's see. It is seated on the river Carrion, 28 miles north-east of Valladolid, and 70 south-east of Leon. The principal manufactures are serges, flannels, and woollen coverlets.

PALERMO, an ancient city of Sicily, in the vale of Mazara, stands on the western shore of a bay of the same name on the north-west coast, near the extremity of a kind of natural amphitheatre formed by rocky mountains. It is the capital of the island, and its situation is remarkably happy and picturesque. In the uniformity, regularity, and neatness of its streets and buildings, it appears to surpass Naples, though it is not so large. Public monuments, palaces, churches, monasteries, fountains, and statues, adorn the interior of the town. Palermo is nearly of a circular form, and consists chiefly of two broad and well built regular streets, the Cassaro and Strada Nuova, which are about a mile long, and cross each other at right angles in the centre, where there is an elegant square ornamented with statues; from this spot is seen the whole of these noble streets, and the principal gates of the city that terminate them.—There are in Palermo upwards of 40 monasteries and 50 convents, together with an immense number of churches. The cathedral, or Madre Chiesa, as it is commonly called, is a magnificent Gothic building of the 12th century, containing several superb monuments of the Norman kings of the island, of the finest porphyry. It is supported within by eighty pillars of oriental granite; and it is divided into a number of chapels, some of which are very rich, especially that of St Rosolia, the patroness of Palermo, whose relics are preserved in a box of silver adorned with precious stones. The royal residence is an extensive and irregular building, but the apartments are of a noble size, and richly decorated. There is in a square fronting the palace, a statue of Philip IV. of Sicily, surrounded with four other statues of fine marble. The palaces belonging to the princess are, in general, elegant; the houses of the nobility are likewise fine buildings, though their outward effect is destroyed by their lower part being converted into stables and coach-houses. The buildings of the university are on a large scale, and contain an observatory and cabinets of natural history and medals. The chief public walk in this city is the Marina, a terrace nearly 80 paces broad, and extending upwards of a mile along the shore, and having in its centre a superb temple, which, in summer, is used as an orchestra. The public gardens adjoining to this walk are laid out with great taste: and there is likewise a botanical garden, containing a valuable collection of plants. The country between Palermo and the mountains is one of the richest plains in the world, the whole appearing a delightful garden filled with trees, and watered by fountains and rivulets. The bay of Palermo has a most picturesque appearance, and is surrounded for many miles with a most delightful country, enclosed by romantic rocks and mountains. At a former period, the town was encompassed by a strong wall, but, except towards the sea, the fortifications are now neglected.

Palermo has suffered greatly at different periods from earthquakes, and it was greatly damaged by a fire in 1720. The climate is extremely warm in summer, and in winter the heat seldom falls below 50° of Fahrenheit. While the sirocco continues to blow, the heat is oppressive. The inhabitants of this city amount to 130,000, a large portion of which number consists of nobility, clergy, and beggars. Many of the nobility are without resources to maintain their dignity. In the streets the women hide their heads in black veils, a very ancient mode of dress in Sicily. Palermo is the seat of the viceroy and the Sicilian parliament, and the residence of the principal nobility, and is the see of an archbishop, who is primate of all Sicily. The civil government is vested in the chief magistrate and six senators. The chief magistrate is appointed annually by the king or the viceroy; he is generally a nobleman of the highest rank.

The trade of this city consists chiefly of silk, in which about 900 looms are employed. Beautiful gloves and stockings are manufactured of the silk-thread obtained from a species of fish, (the *pinna marina,*) which is caught on the north coast of Sicily. The exports are silk and satins, wine, oil, and brandy, together with considerable quantities of fish. The harbour, defended by a mole and two castles, is so spacious as to be capable of containing thirty sail of the line, and several hundred merchantmen. But it is open to the swell of the sea from the north-east, and even at the anchoring-place ships are insecure when a westerly wind blows.

It is not customary, in Palermo, to bury the dead. Captain Sutherland, in his tour to Constantinople, informs us, that the dead bodies are carried to the Capuchin convent, which is one of the largest in Italy; "where, after the funeral service is performed, they are dried in a stove, heated by a composition of lime, which makes the skin adhere to the bones. They are then placed erect in niches, and fastened to the wall by the back or neck. A piece of coarse drab is thrown over the shoulders, and round the waist; and their hands are tied together, holding a piece of paper with their epitaph, which is simply their names, age, and when they died." "The relations of the deceased," continues the same writer, "are bound to send two wax tapers every year for the use of the convent; in default of which the corpse is taken down and thrown into the charnel-house. Were it not for the number of vacancies occasioned by the non-payment of this stipend, the Capuchins would be unable to find niches for the number of men who must die every year in so populous a city. Women are dried as well as the men, but are not exposed. Nobles are shut up in chests."[*]

In 1799 Palermo became the residence of the court when the French became masters of Naples, and it continued so till 1815, when Naples was regained, and the court returned to that city. It is 110 miles west from Messina, and 180 south by west from Naples. East Long. of observatory 13° 22′. North Lat. 38° 6′ 44″.

PALESTINE. See CANAAN, land of, and JUDAEA, in this work. See also Clarke's *Travels*, Vol. II.; Chateaubriand's *Travels*; Buckingham's *Travels in Palestine*; Burckhardt's *Travels in Syria*; and Wilson's *Travels in Palestine*.

PALESTRINA, anciently called *Prœneste*, a town of Italy in Campagna di Roma, celebrated in ancient history for the temple of Fortune, the ruins of which may yet be seen.

PALESTRINA, one of the most considerable of the islands called the Lagunes, near Venice. It has a town of the same name six miles south from Venice.

PALEY, Rev. Dr WILLIAM, an eminent, moral, theological, and political writer, was born at Peterborough, in Northamptonshire, in 1743, and educated under his father, who was master of Giggleswick school in Yorkshire. In his sixteenth year he entered the university of Cambridge as a sizer of Christ's college. Though, in the outset of his academical career, he was by no means so ardent a student as his future celebrity may lead us to imagine, he afterwards devoted himself, in the most indefatigable manner, to the university studies. According to his own account, he spent the first two years of his under-graduateship happily, but unprofitably. "I was," says he "constantly in society, where we were not immoral, but idle, and rather expensive. At the commencement of my third year, however, after having left the party at rather a late hour in the evening, I was awaked at five in the morning by one of my companions, who stood at my bedside, and said, 'Paley, I have been thinking what a fool you are. I could do nothing, probably, were I to try, and can afford the life I lead; *you* could do every thing, and cannot afford it. I have had,' continued he, 'no sleep, during the whole night, on account of these reflections, and am now come solemnly to inform you that, if you persist in your indolence, I must renounce your society.' I was so struck," says Paley, "with the visit and the visitor, that I lay in my bed great part of the day, and formed my plan. I ordered my bed-maker to prepare my fire every evening, in order that it might be lighted by myself. I rose at five,—read during the whole of the day, except such hours as chapel and hall required, allotting to each portion of time its peculiar branch of study." Thus the nature of the life he was leading being seen by him in its real aspect, proved the happy cause of his relinquishing the charms of company and dissipation, and applying himself with renewed ardour to study.

After obtaining his bachelor's degree, Paley accepted the situation of assistant in an academy at Greenwich, where he remained about three years. Returning to Christ's college in 1766, he was elected a fellow of that society, and was, not long after, associated in the tuition, together with Dr Law. This union of labours cemented intimate friendship between Dr Paley and Dr Law, which was highly honourable to both, and no doubt derived additional strength, on Dr Law's part, from the pleasure of conferring favours, and on Dr Paley's from gratitude for having received them. While he continued in the university, Dr Paley not unfrequently officiated as a preacher; and from the excellence of his sermons, and his impressive manner of delivering them,—from his happy art, in a word, of familiarising the most difficult points, and of presenting his ideas in a form which was interesting to the highest capacity, and intelligible to the meanest,—he was remarkably well received. At college, Dr Paley's time was spent in great exertion. He prepared his public lectures with much study and labour; and some hours of every day were bestowed by him on private pupils. His lectures on moral and political philosophy, and on the Greek Testament, comprised the general outlines of the works which have attached celebrity to his name. Indeed, those works owe their origin to the situation which imposed upon our author the duty of delivering the lectures.

Dr Paley left college, and married in 1776; and as his talents began about this period to be fully appreciated, his hopes of church preferment were, ere long, fully realized. The Bishop of Carlisle, who had given him a living in Cumberland, now presented him to that of Appleby in Westmoreland, together with Dalston. In 1782 Dr Paley obtained the archdeaconry of Carlisle; and he afterwards exchanged the living of Appleby, for a prebendal stall in the cathedral of the same place. He published, in 1785, his Elements of Moral and Political Philosophy—a highly popular work, the dedication of which will bear a comparison with any composition of the same kind in the English language. So great was the demand for the Moral and Political Philosophy, that a thirteenth edition was called for in the year 1800. As a book of examination it was soon introduced into the university of Cambridge, which circumstance insured it an annual succession of purchasers. The public were well prepared to admire his next publication, the Horae Paulinæ, or Observations on the Epistles of St. Paul. It was published in 1790; his View of the Evidences of Christianity appeared four years afterwards; and his Natural Theology was given to the world in 1801. Shortly after the publication of the View of the Evidences, the Bishop of London gave him a vacant prebend in the cathedral of St Paul's; at the same time he was offered the subdeanery of Lincoln; and in a few weeks after the lucrative living of Bishop Wearmouth was added to this accumulation by the Bishop of Durham. After the death of his patron, Dr Edmund Law, Dr Paley contributed to the Encylopædia Britannica a short account of that eminent prelate, which is very interesting, though it appears to be rather a character than a life.

The Natural Theology of our author appeared at a time when he was labouring under a malady which ultimately terminated his valuable existence, at Bishop Wearmouth, in 1805. In the firmness with which he met the approach of death, he verified the observation of Mr Addison, "See in what peace a Christian can die!" His remains were interred in the cathedral of Carlisle. Dr Paley was rather above the middle size, and inclined to corpulency. His countenance, though pleasing, was but little expressive of the vigour and versatility of his mind.

Besides the productions which have been mentioned, Dr Paley published some tracts and sermons. It may be remarked, that the works of this distinguished writer display powerful reasoning and profound and accurate thinking, and entitle their author to a conspicuous place among the benefactors of mankind. To the general reader the Moral and Political Philosophy possesses no ordinary attractions; and of the *Horae Paulinae* Mr Gisborne observes, that it possesses the combined merits of originality, acuteness, and sound reasoning, in a degree seldom equalled. Though there may be various opinions with regard to his ethical and political principles, there can be but one sentiment respecting his theological writings, which are at once pious, generous, and conclusive. Dr Paley's character was exemplary in all the private relations of life, and his conduct as a minister of the gospel was altogether calculated to secure the cordial esteem and affection of his flock. See Dr Paley's *Works*, with his *Life* prefixed, edited by Mr Alexander Chalmers, Lond. 1821.

**PALIBOTHRA**, the ancient name of Patna, a city of Hindostan, and the capital of the province of Bahar. See HINDOSTAN.

**PALISADE**, or PALISADO, in fortification, an inclosure of stakes or piles driven into the ground at stated distances, braced together by rails nailed across them near the top, and secured by strong posts planted at the distance from each other of four or five yards. See WAR.

**PALLADIUM.** See CHEMISTRY.

**PALLADIUM**, a famous statue of the goddess Pallas, which was supposed to have dropped from heaven, and was preserved in Troy in the temple of Minerva. Its height was about three cubits, and it represented the goddess sitting and holding a pike in her right hand and a distaff or spindle in her left. Regarding this statue, the opinions of ancient authors are various. On its preservation, however, the safety of Troy was universally supposed to depend; and therefore the Greeks, during the Trojan war, commissioned Ulysses and Diomedes to steal it. By some it is asserted, that the true Palladium was not carried away from Troy by the Greeks, but merely a statue of similar size and shape which stood near it, and that the true Palladium was conveyed safely from Troy to Italy by Æneas, and was afterwards preserved at Rome in the temple of Vesta. This statue was esteemed the destiny of Rome, and several others were made perfectly like it to secure it from being stolen as was that of Troy, which, by an oracle, Apollo declared should never be taken so long as the Palladium remained within its walls.

PALLAS, Peter Simon, a distinguished naturalist, was born in 1741 at Berlin, where his father was professor of surgery in the university. Having been educated for the medical profession, he was able, at the early age of 17, to read a course of public lectures on anatomy. In 1758 he entered the university of Halle, where he prosecuted the study of natural history; in the following year he removed to Gottingen, and in 1760 he obtained his doctor's degree at Leyden. Not long after he repaired to London, where he assiduously applied himself to the study of natural science. On his return to Berlin in 1761 he began to prepare the materials for a *Fauna Insectorum Marchica*. Pallas afterwards went to reside at the Hague, and he was elected a fellow of the Royal society of London in the year 1764. By the publication of his *Elenchus Zoophytorum*, he first distinguished himself as a naturalist. This work was some time after followed by the *Miscellanea Zoologica*; and having, by his father's desire, returned to Berlin, and commenced publishing his *Spicilegia Zoologica*, he was honoured with an invitation from the Empress Catherine to become professor of natural history in the Imperial Russian academy. Of this offer he accepted; and on his arrival in Petersburgh the management of the scientific expedition to the east of the Volga, and to the remote parts of Siberia, was committed to him. On this expedition he accordingly set out in June 1768, and, after an absence of six years, he returned to Petersburgh, where he published an account of his journey, in 5 vols. 4to.

About the year 1784, Pallas was appointed a member of the Board of Mines, with an additional salary of L.200 per annum, and was honoured with the order of St Vladimir. The empress, proposing to purchase his collection of natural history, requested him to prepare the catalogue and determine the price; and when the catalogue was presented to her Majesty, and the sum of 15,000 rubles mentioned by the naturalist, she wrote, with her own hand, as follows: "Mr Pallas understands natural history much better than figures; he ought to have charged 20,000 instead of 15,000 rubles for so many valuable articles. The empress, however, takes upon herself to correct the mistake, and hereby orders her treasurer to pay 20,000 rubles. At the same time, Mr Pallas shall not be deprived of his collection, which shall continue in his own possession during his life, as he so well understands how to render it most useful to mankind." Pallas travelled to the Crimea in the year 1794, and he afterwards published his *Physical and Topographical Picture of Taurida*, which contains a description of that interesting peninsula. By the munificence of the empress, he was enabled to settle in the Crimea for the sake of his health, where, on his estate of Akmetchet, he spent great part of his latter years. While on a visit to his native city, this celebrated naturalist died in September 1811. Besides the works already noticed, Pallas was the author of *Novae Species Quadrupedum e glirium ordine*; *Enumeratio Plantarum quae in horto Procopii a Demidof Moscua vigent*; New Northern Collections on various subjects in Geography, Natural History, and Agriculture. Several of his Memoirs are published among those of the Imperial Russian Academy, and he likewise communicated three papers to the Royal society of London, which were published in the *Phil. Trans.*

PALM, a measure of length taken from the extent of the hand. The Roman palm was of two kinds, the greater and the smaller;—the great palm was equal to about eight inches and a-half; the small one, taken from the breadth of the hand, was equal to about three inches. The Greek palm was likewise of two kinds; the great palm measured about four inches, and the small rather more than three. The modern palm varies in different countries.

| | Inches. |
|---|---|
| At Rome it is - | 8.2916 |
| Naples, according to Riccioli | 8. |
| ——— according to others | 8.5833 |
| Genoa and France - | 9.75 |
| Morocco and Fez - | 7.1666 |
| England - | 3 |

PALM SUNDAY, the last Sunday in Lent. It is so denominated in commemoration of our Saviour's triumphal entry into Jerusalem, when the multitude that attended him strewed branches on his way. A ceremony was in use among the primitive Christians of bearing palms eight days before the feast of the passover, described by St Matthew chap. xxi. St Mark, chap. xi. and St Luke, chap. xix.

PALMA, one of the Canary islands. See Canary Islands.

PALMA, or Majorca, the capital of the island of Majorca. See Majorca.

PALMERSTON'S ISLAND, an island in the South Pacific ocean, discovered by Captain Cook in 1744, and consisting of eight or more small islets, connected by a reef of coral rocks.

PALMISTRY, the fallacious art of foretelling the destinies of individuals from the lines on the hand. See Magic.

PALMYRA, or Tadmor, an ancient city of Syria, now entirely in a state of ruins, is situated 200 miles east of the Mediterranean, and 150 south-east of Aleppo, in North Lat. 34° 35′ and West Lon. 38° 39′. Of the origin of Palmyra, which anciently was one of the most considerable cities in the world, the capital of the territories of Queen Zenobia, no certain information can be given. Palmyra is supposed to be the "Tadmor in the wilderness" mentioned in the Sacred Writings; and, indeed, this opinion seems not unfounded, when we consider that the two terms are synonymous. "The name of Tadmor or Palmyra," Mr Gibbon observes, "by its signification in the Syriac, as well as in the Latin language, denoted the multitude of *palm trees* which afforded shade and verdure to that temperate region." Josephus gives a similar account, and likewise refutes, in a satisfactory manner, the opinion that Solomon was too wise and prudent to found such a

Palmyra.

city in a distant and unpeopled corner of his dominions. "The reason," he says, "why Solomon built this city so remote from the parts of Syria that are inhabited, is this, that below there is no water to be had, and that it is in that place only where there are springs and pits of water," and that it was designed to form the emporium of the commerce carried on between the Persian gulf and the mercantile cities on the banks of the Mediterranean. M. Volney adduces several powerful arguments to prove that the Persian gulf was the centre of the most ancient commerce of the eastern world; and that it was with the prospect of obtaining a shorter route, by means of the Euphrates, that the king of Israel directed his attention to Tadmor, distant from it but three days journey. "We may even reasonably conjecture, when we reflect on the revolutions of the following ages, that this commerce became a principal cause of those various wars in Lower Asia, for which the barren chronicles of those early times assign no motives. If after the reign of Solomon the Assyrians of Nineveh turned their ambitious views towards Chaldee, and the lower part of the Euphrates, it was with the intention to approach that great source of opulence, the Persian gulf. If Babylon, from being the vassal of Nineveh, in a short time became her rival, and the seat of a new empire, it was because her situation rendered her the emporium of this lucrative trade; in short, if the kings of this great city waged perpetual wars with Jerusalem and Tyre, their object was not to despoil the cities of their riches, but to prevent their invading their trade by the way of the Red sea. An historian, who has informed us that Nabuchodonosor, before he laid siege to Jerusalem, took possession of Tadmor, clearly indicates that the latter city acted in concert with the two neighbouring capitals. Their gradual decline became, under the Persian empire, and the successors of Alexander, the efficient cause of the sudden greatness of Palmyra in the time of the Parthians and Romans. She then enjoyed a long peace for many centuries, which allowed her inhabitants to erect those monuments of opulence whose ruins we still admire."

The ruins of Palmyra are singularly stupendous, and are situated in the midst of a sandy desert, bounded on three sides by long ridges of mountains. Above a century ago they were accidentally discovered by some English travellers from Aleppo. The *original* buildings, it may be observed, have been long since entirely obliterated; and as the city has been more than once sacked since Solomon's time, the edifices, whose ruins yet remain, have been, doubtless, erected long posterior to it. No inscription was discovered by Mr Wood, who visited Palmyra in 1751, older than the Christian era; and the style of architecture, he informs us, is all either of Greek or Roman origin. The Palmyrene ruins consist of temples, palaces, and porticoes of Grecian architecture, and occupy an area of three miles in circumference. To give an adequate account of them within our limits is impossible. Alluding to the sepulchres of the ancient Palmyrenes, Mr Wood says: 'We had scarcely passed these venerable buildings, when the hills opening discovered to us, all at once, the greatest quantity of ruins we had ever seen; and behind them, towards the Euphrates, a flat waste, as far as the eye could reach, without any object which shewed either life or motion. It is scarce possible to imagine any thing more striking than this view. So great a number of Corinthian pillars, with so little wall or solid building, afforded a most romantic variety of prospect." Mr Bruce, who visited these ruins before he penetrated into Abyssinia, gives a similar account. "When we arrived at the top of the hill," says he, "there opened before us the most astonishing stupendous sight that perhaps ever appeared to mortal eyes. The whole plain below, which was very extensive, was covered so thick with magnificent buildings, as that one seemed to touch the other, all of fine proportions, all of agreeable forms, all composed of white stone, which at that distance appeared like marble. At the end of it stood the palace of the Sun, a building worthy to close so magnificent a scene." The account given by M. Volney is very animated.—"We sometimes," says he, "find a palace, of which nothing remains but the courts and walls; sometimes a temple, whose peristyle is half thrown down, and now a portico, a gallery, or a triumphal arch. Here stand groupes of columns, whose symmetry is destroyed by the fall of many of them; there we see them ranged in rows of such length, that, similar to rows of trees, they deceive the sight, and assume the appearance of continued walls. On which side soever we look, the earth is strewed with vast stones, half buried, with broken entablatures, damaged capitals, mutilated friezes, disfigured reliefs, effaced sculptures, violated tombs, and altars defiled by mud." Of all the monuments of art and magnificence in this city, the most considerable is the temple of the Sun. The whole space containing its ruins is a square of 220 yards, encompassed with a stately wall, and adorned with pilasters within and without, to the number of 62 on a side. Within the court are the remains of two rows of very noble marble pillars, 37 feet in height; the temple was encompassed with another row of pillars 50 feet in height; but the temple itself was only 33 yards in length, and about 14 in breadth. North of this place there is an obelisk consisting of seven large stones, besides its capital and the wreathed work about it, nearly 50 feet high, and just above the pedestal five in circumference. There are two others at a small distance, and a fragment of a third, which seems to indicate that, at one period, they were a continued row. There is likewise a piazza 40 feet broad, and more than half a mile long, inclosed with two rows of marble pillars 26 feet high, and eight or nine feet in compass, and the number of these is supposed not to have been less than 560. At a small distance from this piazza are to be seen the ruins of a superb edifice supposed to have been a banqueting-house, beautifully finished with the best kind of marble. There are in the west side of the piazza several apertures for gates into the court of the palace, each decorated with four porphyry pillars, 30 feet in length and nine in circumference. Several other marble pillars are variously arranged on the pedestals, on which there seems to have been inscriptions, though they are now

Palmyra.

entirely illegible. The sepulchres of the ancient Palmyrenes, which are numerous, are square towers, varying in size and splendour.

Of Palmyra, the *historical notices* are not very satisfactory. It is first mentioned by Pliny as a city of great importance, enjoying the advantages of a complete neutrality between the Romans and Parthians, till, after the victories of Trajan, it was subjugated by the Romans, and continued so for above a century and a-half. From the time of Adrian to that of Aurelian, this city gradually increased in wealth and power, and the Palmyrenes, who aided Alexander Severus against the Parthians, again distinguished themselves in the reign of Gallienus under the celebrated Oudenatus, who obtained several glorious victories over the Persians, and was thereafter made the associate of Gallienus in the Roman empire; an alliance which Zenobia, his queen and successor, afterwards broke, making herself sole mistress of Syria and Mesopotamia. Zenobia was not destined long to enjoy her triumphs; she was overcome by the Emperor Aurelian, and she ultimately stained her character, otherwise glorious, by securing her own life at the expense of those of her subjects, among whom was her secretary Longinus, a name that must be ever remembered with admiration and regret. From the period of its being taken by Aurelius, this city gradually verged to decay. Nothing was attempted by the Mahometans, into whose hands it afterwards fell, to save it from destruction; and the remains of this city now speak in language the most emphatic of the instability of earthly grandeur. Perhaps a more glorious city than Palmyra never existed; it was not more extraordinary for magnificent buildings, than for the eminent personages who once flourished in it. From its being situated between Egypt, Persia, and Greece, it partook of the manners of these nations, imitating the Egyptians in their funeral rites, the Persians in their luxury, and the Greeks in their buildings. There are among the ruins of Palmyra a number of huts of the Arabs; and about thirty or forty wretched families at present live in huts erected in the court of the temple of the Sun. See Wood's *Ruins of Palmyra*, Volney's *Travels*, Bruce's *Travels*, (Introduction,) and Swinton's *Explication of the Inscriptions at Palmyra*.

PALSY, a disease wherein the body, or some of its members, lose their motion, and even their sensation or feeling. See MEDICINE.

PAMPAS. See BUENOS AYRES.

PAMPELUNA, or PAMPELONA, anciently *Pampeiopolis*, the capital of the kingdom of Navarre, in Spain, is seated on the river Arga, in West Long. 1° 41′ 15″, and North Lat. 42° 59′ 57″. It is defended by two castles, one of which stands upon a rock immediately without the walls, and has five bastions, and good ditches, a handsome tower, a square adorned with trees, several magazines, and an armoury. Pampeluna is confused and ill built; but two of the squares contain tolerably elegant buildings, and the one employed for the bull-fights is very spacious. In the public edifices there is nothing remarkable. The only articles of manufacture are leather, coarse cloth, parchment, wax, and earthern ware, and the trade of the town consists chiefly in carpeting. The population is estimated at 14,000. The French on their invasion of Spain took Pampeluna, which however surrendered to the allied powers in 1813.

PAN, in mythology, the son of Mercury and Penelope, and the deity who presided over huntsmen, shepherds, and all those whose occupations obliged them to frequent the fields. He was particularly worshipped among the Arcadians, to whom he issued oracles, and who in honour of him celebrated the Lupercalia. The worship and feasts of Pan were, by Evander, carried to Rome, where the god of shepherds was adopted amongst the deities under the appellations of Lupercus and Lycaeus. From the circumstance of Pan, one of the captains of Bacchus, having put a numerous army to route by a noise which his soldiers raised in a rocky valley, favoured with a great number of echoes, those ill grounded fears which are, not unfrequently, apt to seize men, has obtained the name of *panic* fear. In armies, as well as individuals, this kind of fear has been often exemplified. Thus the powerful army of Brennus was thrown into unspeakable consternation at Rome without any reasonable cause of dread.

PANAMA, a province of South America, distinguished by the name of the isthmus of Panama, is bounded on the north by the Spanish main, on the south by the Pacific ocean, on the east by the province of Darien, and on the west by Veragua. It forms the junction of North and South America, having a chain of mountains, covered with forests, stretching through its whole extent, which renders it a barrier sufficiently powerful to resist the impulse of two opposite streams. This province is neither very salubrious nor very fertile; but a brisk trade, for which it was conveniently situated, gave it, at one period, some degree of importance. As the rains fall here during two-thirds of the year, the valleys are marshy, and frequently overflowed. The Chagre, in which are many alligators, is the principal river. In many places, the natives, who go naked, construct their dwellings upon trees, to avoid the damp soil and the reptiles engendered in the putrid waters.

*Panama*, the capital, is situated on the bay of the same name. It was the depot of all the traffic of the province, and had some pretensions to be thought both elegant and wealthy before the abolition of commerce by the galleons. The harbour is excellent and commodious, and there is a pearl fishery in it.

PANATHENÆA, an ancient Athenian festival in honour of the goddess Minerva. Till the time of Theseus, it appears to have been denominated Athenæa; and the name *Panathenæa*, or the feast of all Attica, was derived from the circumstance of that prince uniting all the people of Attica into one republic, so that they all assisted at the feast. Under this name there were two festivals, the greater and the lesser, and in both the ceremonies were the same, excepting that a banner whereon the actions of Minerva were represented in embroidery, with the names of such as had signalized themselves in the service of the republic. was borne only at the greater. The greater Panathenæa was observed every fifth year, the lesser every three, or, as some assert, annually. For three different kinds of combat.

namely, foot and horse races, athletic exercises, and poetical and musical competition, prizes were instituted.

PANAY, one of the Philippine islands, lying between those of Paragoa and Negros, is 250 miles in circuit, and is watered by various rivers and brooks. It contains about 16,000 Indians, who are expert huntsmen, the country being full of wild boars and deer. The blacks, called *Negrilloes* by the Spaniards, were the first inhabitants of Panay, and were driven into the thick woods by the Bisayas, who conquered it. So swift of foot are they, that they frequently overtake the animals of the chase. The most uncouth parts of the mountains are occupied by them, and they depend entirely on the use of their bow and arrows for subsistence. See PHILIPPINE ISLANDS.

PANCRAS, a considerable parish of Middlesex, situated two miles north-west from London, and comprising about 2700 acres of land. Owing to the very rapid increase of houses since the year 1765, when all the streets near Percy chapel were built, this parish is the most extensive and populous of any in the neighbourhood of London. In 1811 the inhabitants were estimated at 46,333. Pancras, which is said to have been a parish before the Conquest, took its name from the saint to whom the church is dedicated. Its church-yard is the principal place of interment for the Roman Catholics who die in the metropolis. Within the parish there are several large chapels appropriated to public worship; and the institutions for charitable and other purposes are numerous and well-supported. Bagnigge Wells, a favourite place of public entertainment, is situated in this parish, in the valley between Pentonville and the Foundling hospital. It was first opened as a tea-garden in 1767. At the northern extremity of Pancras is Caenwood, noted for having been the country seat of the celebrated earl of Mansfield.

PANCREAS. See ANATOMY.

PANDECTS, PANDECTAE, in the civil law, the digest made by Justinian's order of 534 decisions of the ancient lawyers on questions occurring in the civil law, to which, by an epistle prefixed to them, he gave the force and authority of law. The pandects, constituting the first part of the body of the civil law, consist of fifty books.

PANDORA, in mythology, the first woman made by Vulcan, at the request of Jupiter, and endowed with gifts by all the gods and goddesses, whose box contained all sorts of mischiefs, with Hope at the bottom. According to the fable, Epimetheus, the brother of Prometheus, opened the fatal box given to Pandora by Jupiter, when instantly all the diseases and evils with which it was filled spread over the earth, and Hope only remained. Hesiod says Pandora was the first woman.

PANEL, is commonly used to denote a schedule or roll, containing the names of such jurors as the sheriff returns to pass upon any trial. The impanelling of a jury is merely the entering of their names into a panel, by the sheriff. Panel, in Scots law, signifies the individual who, for some crime, takes his trial before the court of Justiciary.

PANNONIA, an extensive country of Europe, which was known to the Romans in the time of Augustus, and had for its boundaries the Danube on the north, Dalmatia on the south, Noricum on the west, and Moesia on the east. The Scordisci and Taurisci, who were originally Gauls, were the more ancient inhabitants of Pannonia.

PANORAMA, from the Greek, signifying *every thing*, and *to see*, is the term applied to a picture which exhibits a succession of objects, such as may be, by the rays of light, intercepted by the surface of a hollow sphere, or cylinder, from all points of external objects to the eye, in the centre of the sphere, or at a fixed point in the axis of the cylinder. Mr Baker, whose fine panoramic paintings are well known, is considered the inventor of this delightful method of representing nature: he secured, by patent, the exclusive right to the use of it.

PANTHEISM, an ancient species of idolatry, in which the universe was considered as the supreme god. This absurd system was differently modified by different philosophers, but who was the original inventor of it is unknown.

PANTHEON, from the Greek, signifying *all* and *god*, a beautiful edifice, of a circular form, at Rome, anciently a temple dedicated to all the gods. From the inscription on the frieze of the portico, M. AGRIPPA, L. F. COS. TERTIUM FECIT, this celebrated structure is generally believed to have been erected by Agrippa, son-in-law to Augustus; but some antiquaries and artists have maintained that it existed as early as the commonwealth, and that it only received additions and embellishments from Agrippa. The Pantheon, when completed, was extremely magnificent. Such, indeed, was the grandeur of this building, that Pliny was induced to rank it among the wonders of the world. It was dedicated by Agrippa to Jupiter Ultor, or Jupiter the Revenger, and received the name Pantheon owing to the great number of statues of the gods ranged in seven niches all around it; and because constructed of a circular form to represent heaven, the residence of the gods. This stupendous building is 144 feet in diameter within, and just as much in height, and of the Corinthian order. It has but one door, and the light is admitted through the grand aperture at top. Before each niche are two columns of antique yellow-marble fluted, and of one centre block. The wall of the temple, as high as the grand cornice inclusive, is cased with various sorts of precious marble in compartments, and the frieze is entirely of porphyry.

The pantheon suffered considerable damage in the reign of Tiberius by the eruption of Vesuvius, but was successively repaired by Domitian, Adrian, and Septimius Severus. It continued in all its grandeur till the incursion of Alaric in the time of Honorius, on which occasion it was stripped of its statues and ornaments of gold and silver. About 39 years after, Genseric, king of the Vandals, carried away part of the marbles and statues. Pope Boniface IV. shortly after obtained the Pantheon from the emperor Phocas, and made a church of it, without any alterations in the building, and dedicated it to the Virgin and all the martyrs. It still exists under the appellation Notre Dame de la Rotonda. Being the most per-

Pantograph ‖ Pantomimes.

fect specimen of Roman art which time has spared, or the ancients could have wished to transmit to posterity, it has served as an excellent model to succeeding generations: To it Constantinople is indebted for Santa Sophia, and to it Rome owes the dome of the Vatican.

Another pantheon was built at Rome, which was dedicated to Minerva as the goddess of medicine. The Pantheon of Athens was in many respects little inferior to the one built at Rome by Agrippa. By the Greek Christians it was converted into a place of public worship, and dedicated to the Virgin under the name of Panegia; but it was afterwards changed into a mosque by the Turks.

PANTOGRAPH. See Pentagraph.

PANTOMETER, an instrument for taking all sorts of angles, distances, and elevations.

PANTOMIMES, among the ancients, were representations in which there was no speaking; and the actors, who bore the same name with their scenic exhibitions, expressed every thing merely by dancing and gestures. In Greece they were very ancient, being, according to some, derived from the heroic times. Plato conceived great pleasure in perusing the pantomimes of Sophron of Syracuse, who flourished in the time of Xerxes. In Rome it was so late as the time of Augustus ere the pantomimes were introduced; and the actors distinguished themselves by a licentious imitation of the manners of the times. Even at funerals, this kind of diversion was not unfrequent. On such occasions the actors, who were styled archimimes, went before the coffin, and, by their gestures, gave representations of the actions and manners of the deceased. Their dress was various, but always suited pretty nearly to that of the individual they were to imitate. The *crocota*, a garment of a saffron colour, was much used among the Roman pantomimes, in which, as well as in other female dresses, they personated women. According to Mr Gibbon, the pantomimes, who maintained their reputation from the age of Augustus to the sixth century, expressed, without the use of words, the various fables of the gods and heroes of antiquity; and the perfection of their art, which sometimes disarmed the gravity of the philosopher, always excited the applause and wonder of the people. The vast and magnificent theatres of Rome were filled by 3000 female dancers and by 3000 singers, with the masters of the respective choruses. Such was the popular favour which they enjoyed, that in a time of scarcity, when all strangers were banished from the city, the merit of contributing to the public pleasures exempted them from a law which was strictly executed against the professors of the liberal arts.

The pantomimes common in England differ in many respects from those of ancient Greece and Rome, but they retain the name, because they consist in the representation of things by signs and gestures.

PAPA-STOUR. See Zetland.

# PAPER-MAKING.

History.

PAPER-MAKING, the art of manufacturing paper from vegetable substances. In different nations and at different periods, the materials have been various of which paper has been made. With regard to the manner of making it, and the materials employed therein, paper is reducible to several kinds; as Egyptian paper, made of the papyrus, a plant which is a native of Egypt, and which evidently gave its name to paper; incombustible paper, made of asbestos or asbestos; bark paper, made of the inner rind of several trees; cotton paper, and European paper, manufactured from linen rags.

Before the invention of paper, the materials on which mankind contrived to write their sentiments were extremely various: They made use of stones, bricks, the leaves of herbs and trees, and their rinds or barks; tables of wood, wax, and ivory; likewise plates of lead, linen rolls, &c.

The ancients at an early period employed the papyrus or biblos as a substance for writing upon; and of the process of preparing it, the following description is given by Pliny, (lib. xiii. cap. 11.) They divided with a kind of needle the stem of the papyrus into thin plates or slender pellicles, each of them as large as the plant would admit. As they were separated from the reed they were extended on a table, and laid across each other at right angles. In this state they were moistened by the water of the Nile, and, while wet, were put under a press, and afterwards exposed to the rays of the sun.

The paper of Egypt constituted an important branch of commerce, and it was used in France and Italy and other European countries. At what time the fabrication of this paper entirely ceased is not recorded. In Greece the Egyptian paper was supplanted by the invention of a superior kind of paper made from cotton, and denominated *charta bombycina*. According to Father Montfaucon, cotton paper was in all probability discovered about the ninth century, although no dated manuscript has been found written on this paper older than A. D. 1050. The use of this paper was common in Greece about the commencement of the 12th century. Manuscripts on cotton paper, which appear to be of the 10th century, are preserved in the Grand library at Paris.

Asbestus, a mineral substance belonging to the magnesian genus, was in ancient times reduced into a pulp, and formed into paper, which retained the incombustible property of the cloth made of the same substance, and employed for wrapping up the bodies of the dead. See Geology. The method of fabricating incombustible paper is described in the Philosophical Transactions, No. 166. As this kind of paper is of a very slender consistency, it is remarkable chiefly as an object of curiosity; and its only excellence is, that, when it is cast into the fire, the writing disappears.

The Japanese fabricate paper from the bark of several trees, especially the *morus papifera sativa*, or true paper tree. Of such amazing strength is the paper made by them, that the materials of which it consists might be manufactured into ropes. Kempfer has given a minute description of the trees employed in Japan for the making of paper, which may prove serviceable in leading botanists to the discovery of European plants and shrubs adapted for the manufacture of paper.

In China, a great deal of paper is fabricated of the rinds or barks of trees, especially the mulberry tree and elm, but chiefly of the fibres and bark of the bamboo. Indeed, the Chinese were acquainted with the manufacture of paper from vegetables, reduced to a pulp, long before it was practised in Europe, and they have greatly improved the art. There being various kinds of paper in China, each province of that extensive empire has its peculiar paper. That of Setchuen is made of linen rags, as in Europe; that of Fo-kien, of young bamboo; that of the northern provinces, of the interior bark of the mulberry; that of the province of Kiang-nan, of the skin found in the webs of the silk-worm; and that of the province of Hu-guang is made of materials furnished by the tree chu or ko-chu. The method of manufacturing paper with the bark of different trees may be instanced in that of the bamboo, which is a kind of cane or hollow reed, divided by knots, but larger, more elastic, and durable than any other reed. In this manufacture the whole substance of the bamboo, consisting of filaments, and a considerable portion of fibrous material, is made use of. This being reduced to pulp, by steeping, boiling, and the mortar, is beat together with the glutinous juice of a plant named *koteng*, till it become a thick and viscous liquor. Into this liquor the workmen plunge their forms or moulds, in order to take out a proper portion for a sheet of paper; which instantly becomes firm and shining, and is detached from the mould by turning down the sheet on the heap of paper already made, without pieces of woollen cloth being interposed, as is usual in Europe. So large are the moulds, that some sheets are more than 12 feet long. To complete the manufacture, the sheets are dipped one by one in alum water, which serves instead of size, and not only hinders the paper from imbibing the ink, but gives it a somewhat varnished appearance. The fine Chinese paper is more soft and smooth than the paper of Europe, and is, therefore, peculiarly adapted for the pencil, which, in that country, is generally employed in writing. All paper, however, made from the bamboo or the bark of trees, is apt to crack and to receive damage from moisture and insects.

The ancients were entirely unacquainted with the manufacture of paper from linen rags. After the most minute search in France and Italy, Montfaucon could find no book written on this paper antecedent to A. D. 1270. It is supposed that the most ancient paper made of linen rags is of Valencia and Catalonia, and that the invention passed from Spain into France. But be this as it may, linen paper was not in general use in Europe till about the commencement of the 14th century. See the Abbé Andrez, *Dell Origine, Progressi, e Stato attuale d'Ogni letteratura*, 8vo, 1782, and Mierman's *Collection*, published at the Hague.

It appears, that the oldest German paper-mill was established at Nuremberg in 1390; and that the first paper-mill in England was established about the year 1588, by a German, jeweller to Queen Elizabeth. As the manufacture was long in a backward state in this country, the finer kinds were imported from France and Holland. Within the last half century, however, great improvements have been effected in this as well as in every other branch of manufacture in Britain. Not only in Kent, the original seat of paper-making, but in almost every district of the island, is paper of the best quality now fabricated.

The old mode of manufacturing paper in France and Holland is not devoid of interest. It was chiefly characterized by the partial putrefaction of the linen rags, and by the use of stampers instead of rollers or cylinders. The rags were well washed, and then placed in their damp state for about 14 days in close vessels, by which means they became slightly putrified. After this, the fibres being placed in large wooden mortars, were bruised and hammered down to a fine pulp, by means of stampers shod with iron, two of which wrought in each mortar alternately. This pulp, or rather paste, was manufactured into paper, in a way somewhat similar to the present method. The practice in England was a little different from that now described. The rags, after undergoing the fermenting process, were laid in a circular wooden bowl, diverging regularly towards the top; in this bowl an iron cylinder worked, the pressure on which was considerable, and acting on the side of the bowl, so that the rags were sufficiently triturated. This method continued in use in this country till about the middle of the last century, when paper-making underwent a thorough change, owing to the invention of the paper-engine in Holland. Since that period the art has been greatly improved. Printing-papers are now preferred machine-made, because the thickness of a sheet is found to be more regular, and the surface better, from its passing between the smooth cylinders. A machine of the full width of 60 inches, is equal to six vats work, and it produces, in 10 hours, from 40 to 50 reams. In Britain there are about 550 mills, 60 of which are machine-mills. There are in Scotland three machines, and about 50 vat-mills; and in Ireland two machines. In general, the paper manufactured in the United Kingdom is superior to what is made in any other part of the world. The next in quality is that of the United States; then that of Holland. There are in France about 250 paper-mills, and about five of Fourdrinier's machines. The number of paper-mills in the Austrian dominions is 300. In Bohemia there are 107; and in the kingdom of Italy 105, famous for making card-paper, a manufacture which it is remarkable has not succeeded in Britain. The paper-mills in the Prussian dominions amount to upwards of 300; Russia has 67, and Sweden about 40 paper-mills. Most of the foreign mills are worked by mallets. In Britain, the manufacture of brown paper is carried on to a vast extent, the consumpt, especially in Manchester and Glasgow, being almost incredible. The exports of paper from this country are very considerable to the East and West Indies, Canada, and the United States.

It now remains to describe the *present mode of ma-*

*nufacturing paper*, both by the hand and by different machines of recent invention, which facilitate and perfect the work. We shall endeavour to give a comprehensive view of the subject, noticing the different branches of the operation in their order.

*The sorting of materials, &c.*—In this country the rags used for making paper are obtained from Germany, through Bremen and Hamburgh, or from the Mediterranean, chiefly from Leghorn, Trieste, and Palermo; besides which, the home collection is considerable. Owing to the different nature of the rags employed, paper-makers, in general, prefer a mixture of the different kinds, in order to combine the good qualities of each, and, as it were, neutralize the unfavourable effects resulting from the use of one sort unmixed. The rags, before they appear at the mill, are sorted, according to their fineness, into four or five kinds; and when brought to the mill, they are cut and carefully re-sorted, an operation which is usually accomplished by women at a frame covered with wire-cloth, and in which there is fixed a part of a scythe about a foot in length, and inclining backwards. On the right is a box, having several compartments for holding the cut rags of different degrees of fineness, and on the left side are placed the uncut rags. These are taken up, a few at a time, and shaken on the table, that the dirt may pass through; after which a piece is taken, and drawn along the sharp side of the scythe that it may be cut into portions of three or four inches square. The rags thus cut are usually arranged into seven or eight sorts; and for paper which may require great strength, the new pieces are set apart. In one day about a hundred weight of rags may be sorted by an active individual, and for this portion of labour the ordinary allowance is from 1s. 4d. to 1s. 6d.

Before the powerful effects of muriatic acid became known, the paper-makers had, in the sorting, not only to attend to the quality, but likewise to the different colours of the rags. But by bleaching the materials of which paper is composed, the best paper, in point of colour, is now produced from any kind of rags, and consequently the only care of the manufacturer is to produce materials adapted to make paper of a fine even surface and strong texture. Sometimes the rags are bleached before they are carried to the engine. The bleaching is however better done when the rags are in the state of half stuff, that is, when they have been once worked by the mill; for, by the separation of the fibres, the acid in the gaseous form has immediate access without danger of injury to the interior parts by too long an action. By the bleaching process, the manufacture is considerably improved with the same materials as were formerly used; and it is surely no small advantage that from such materials as would be of no value without the application of this process an inferior paper is now easily obtained. Some account of the processes for bleaching the materials of paper will be found under the article BLEACHING.

*Dusting.*—The next business to be attended to after the rags are sorted is dusting. For this purpose a revolving cylinder of about six feet in length and four in height, and covered with the same kind of wire-cloth as the tables, is attached to the machinery of the mill, that it may be set in motion with great velocity. Spokes about twenty inches long are fixed in the axle of this cylinder, which prevent the rags from remaining in a mass. A part of the circumference opens for the admission of the rags, and this door being shut, the duster is set in motion. and the dust escapes through the wire cloth. From the duster, the rags are taken to the engine, where, in the space of about six hours, they are usually reduced to pulp. The hard and soft of the same quality, are placed in different lots, or they are reduced together, the soft being put somewhat later into the engine.

*Bruising and washing of the rags.*—The process of triturating the rags merits particular notice. The engines for this purpose are of various construction; but the principle of reducing the rags to paste is essentially the same. A number of engines are employed, according to the extent of the paper-work, the force of water, or other power, or the particular construction of the machinery. The representation of a paper-engine is given in Plate 150. It consists of a large trough, formed of wood, and lined with lead. B B is a division in the engine: C C (Figs. 1. 2.) is the roller made of wood or iron. There are fixed in it, bars, or plates of steel, 1-8th or 1-16th of an inch in thickness, but tapering towards the edge, and projecting a little beyond the wood or iron of the roller. The plate D D (Figs. 2. 3.) slides in a groove, exactly under the roller, but not parallel to it; it consists of bars of the same kind as those of the roller, and five inches broad. The roller is supported in the box E, (Figs. 1. 2.) wherein there is a screw for elevating or depressing it. There is, above the roller, a cover, extending six or eight inches on each side of it. In this cover towards the ends are two frames, (Fig. 2.) E E, covered with wire-cloth and sliding in grooves in the cover, and leaving a space behind F F connected with the pipes G G, (Figs. 1. 2.) Two boards L L are before the frames; they can also be moved. The operation is as follows: By means of the pinion E, the roller is set agoing on the same axle, with a velocity of 160 revolutions in a minute, and from 112 to 130 lbs. of rags are introduced into the engine, with a sufficiency of water to raise the whole to within an inch or two of the brim. The roller is depressed till such time as its bars touch those of the plate; as the rags are impelled through, they are bruised in passing, and the greater portion of them is thrown over the height M. They are here collected and carried round till they again arrive at the roller; are again pushed through, and again round. While this is going on, the pipe N is open, so that water is allowed to flow into the engine, and the boards M M being removed, part of the rags and water are driven up against the frames E E, and the water passes through, and escapes by the pipes G G.

In this way the rags are triturated and washed, provided the supply of spring-water be regular and plentiful. For a washing and beating engine of proper power, a hogshead of water per minute will be sufficient to prepare about six cwt. of rags per day. It is of advantage to make the engine, and more especially the roller, of elm, where iron is not

# PAPER MAKING

PLATE 150

*Fig. 2.*

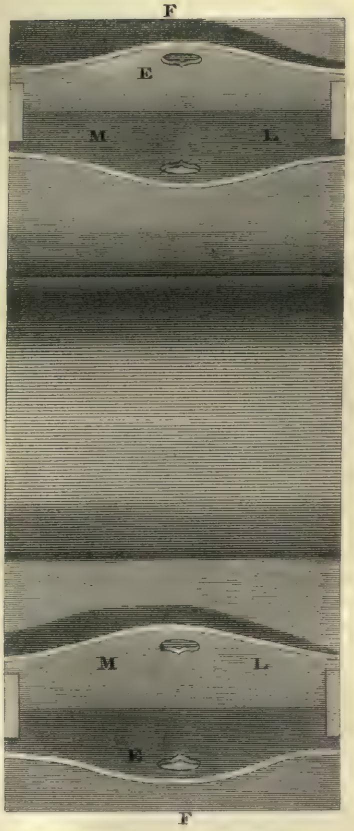


*Fig. 4.*

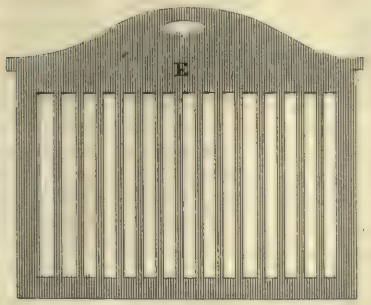


*Fig. 3.*

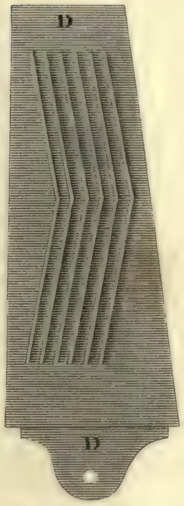
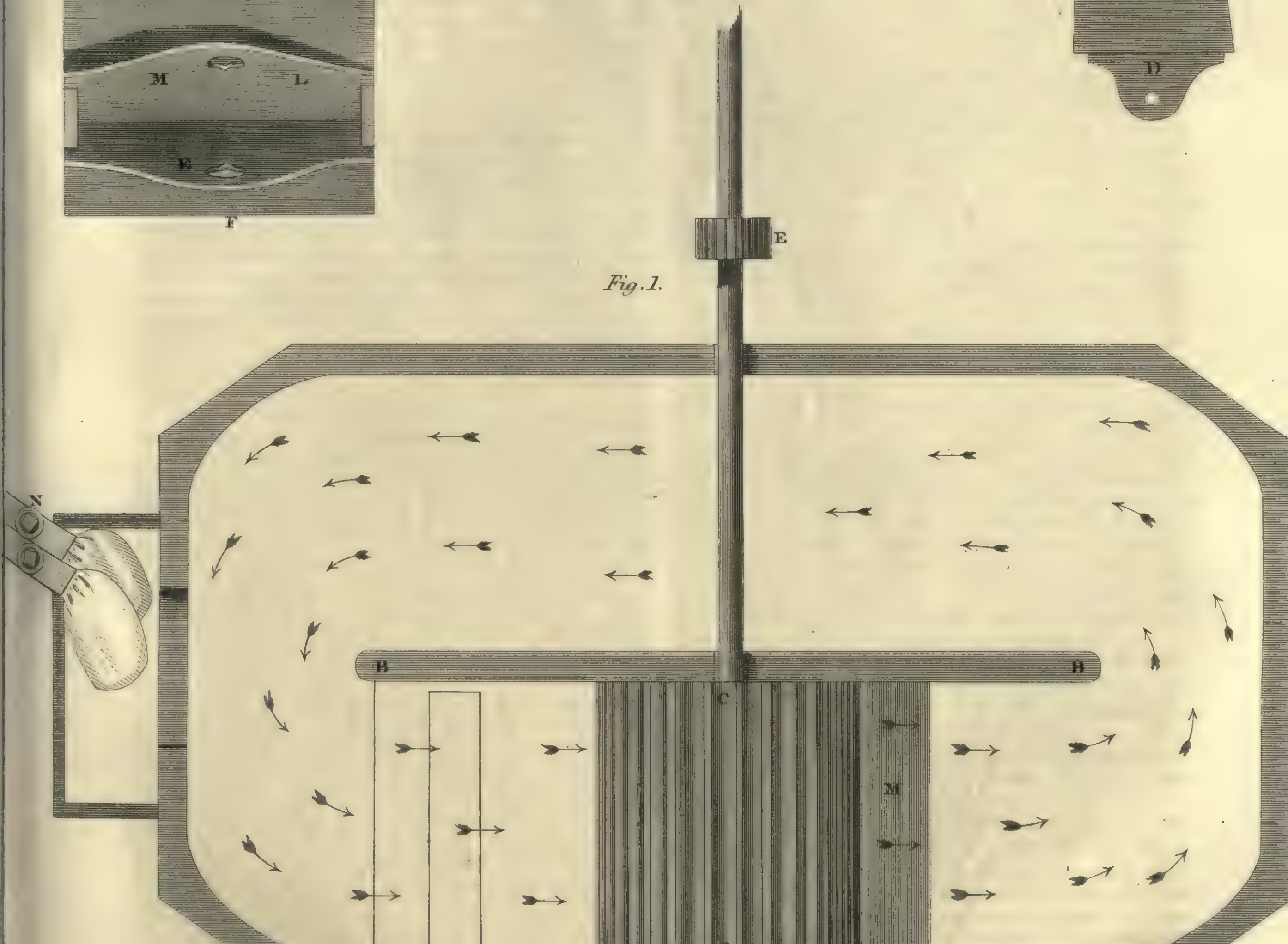


*Fig. 1.*



*Drawn & Engraved by W. H. Lizars for the Encyclopædia Edinensis.*

employed; and to prevent the bad effects of rust from the head of a nail, the head of the engine ought to be lined with lead. A heavy fly-wheel is desirable, as it causes the machinery to go equally. About 20 horse-power is necessary for a five or six vat mill. It is requisite that the roller make about 180 revolutions in a minute in the beating, and from 150 to 160 in the washing engine. After having been about an hour in the engine, the rags are bleached. At present two modes of bleaching are practised, one by the oxymuriatic acid gas, the other by the acid combined in the dry way with quick-lime. To destroy the coarse part of the hemp called *shon* or *sheave*, and which exists in coarse linen rags, especially the strong material obtained from Germany, the rags are boiled in an alkaline solution of potash and lime, for four or five, and sometimes for eight hours. This done, the solution is washed out in the washing engine, and the water being pressed out, they are exposed to the oxymuriatic acid gas; after which the gas is, with the utmost care, washed out. In the second method, the oxymuriate of lime is diffused in water, by agitation, the insoluble matter is thrown out, and the clear liquor is, in a diluted state, put into the engine, where it mixes thoroughly with the rags; and when an hour or more has elapsed, the acid is washed out as carefully as possible. The price of rags being now very low, bleaching is not generally had recourse to; and, indeed, unbleached papers are considered to be of greater durability than what are bleached. After the bleaching, (if that operation be adopted,) the stuff is, for an hour or more, reduced in the washing engine, and it is next put into the beating engine. About three hours and a half are allowed for beating the stuff to a due fineness; and when this has been accomplished, the stuff is let out into the chest, by the opening of a valve in the bottom of the engine.

*Mode of making paper.*—The *chest*, which supplies the vat, or other machinery, is a vessel usually of a rectangular form, and capable of receiving 300 cubic feet, or three enginefuls of stuff. It is made either of wood or stone; when of wood, it is lined with lead. As agitators for keeping the stuff from sinking cannot be advantageously employed where there are angles in the chest, round chests are certainly preferable to those of any other form. By means of a pipe, a portion of the stuff is removed to the vat, and moistened with water. The vat is made either of wood or stone, and is commonly about five feet square, and four deep, with sides, inclining somewhat outwards. A board called the bridge, and having copper ribbands fastened on it lengthwise, is laid along the vat for the mould to glide upon. The workman takes his post on one side of the vat, and a board, one end of which is fixed in the bridge, the other resting on the side of the vat, is situated to the left of him. In the bridge opposite to this board, a nearly upright piece of wood, called the *ass*, is fastened. There is in the vat a copper, which, to keep it hot, communicates with a steam pipe; and this stuff is kept of a uniform thickness in the vat by means of an agitator. The moulds consist of a moveable frame, covered with wire-cloth, which is varied in proportion to the nature of the stuff and the fineness of the paper. A laid mould is composed of a frame of wood, neatly joined at the corners, and across it run wooden bars, at the distance of an inch and a half from each other. The wires again run across these, and consequently along the mould, 15 or 20 covering an inch. Along each of the cross bars a strong raised wire is laid, for the purpose of giving the laid paper its ribbed appearance. With the view of forming the water-mark, a raised piece of wire is sewed in the form of letters, or any particular device, on the wires of the mould. The frame of a wove mould is covered with fine wire-cloth, of from 48 to 64 wires in an inch. A duckel, or moveable raised edging, which must fit very neatly, is used on both moulds.

In the process of making paper, a pair of moulds are always placed on the bridge, and the workman, putting on the duckel, brings the model to a vertical position, dips it in the prepared material, and bringing it to a horizontal position, covers the model with the stuff, and shakes it in a gentle manner. Care must be taken that the mould be held quite even, otherwise one part of the sheet will be more thick than another. On the wire-cloth, the fibrous parts of the stuff regularly arrange themselves, according as the water escapes; and this the workman favours by shaking the mould gently. The workman then pushes the mould along the small board to the left of him, and takes off the duckel, which is immediately received by the coucher, who makes it rest on the ass, in order to get quit of some of the water. Another sheet is now begun by the vat-man, and the felt having been previously laid, the coucher, taking with his left hand the mould, now in a sufficient state of dryness, and placing the sheet of paper upon the felt, where it remains, instantly returns the mould, and pushes it along the bridge. The maker has by this time another sheet ready, which being placed on the ass, he puts down another felt, upon which he couches the sheet. In this way the workman proceeds, laying felt and paper alternately, till a post, which consists of six quires of paper, is prepared. It may be proper to observe that the felts are porous pieces of flannel, the purpose of which is to detach the sheets from the mould, to prevent the sheets adhering together, to imbibe part of the water with which the stuff is charged, and to transmit the whole of it during the operation of pressing.

After the last sheet of the post has been covered with the felt, the workmen draw the whole heap into the press, where, by means of a lever or machinery, a pressure is applied of from 70 to 100 tons. The check being struck off when the pressing is completed, the screw flies very rapidly up, owing to the elasticity of the flannel.

The next process to be attended to is *laying*. The felts are drawn out on the side opposite to where the layer stands. A board is placed in a horizontal position in the press on which the felt is placed; the sheet is taken up, and laid on another board to the other side, and on the board another felt is placed, whence the coucher takes them and puts paper on them anew. The whole is afterwards put into another press, to be freed of the mark of the felt, and of part of the water, by moderate pressing; and after

Process.

it has been all separated, and again pressed to give it a finish, it is removed to the loft. The paper-maker should pay particular attention to the preserving, as well as the highly softening of the grain; for paper which is highly softened is better adapted for writing than what is smoothed by the hammer.

*Drying and Sizing.*—In drying paper, the great object is to admit the external air gradually, and prevent the cords, whereon the sheets are hung, both before and after sizing, from imbibing moisture. In some mills, steam-pipes are used to expedite the drying of paper. When sufficiently dry, the paper is taken down, and carefully laid in heaps. The next operation is the sizing, which is performed in the following manner: About four quires of paper are taken and spread out in the size, care being taken that every part be wetted. The superfluous size is then pressed out, and the paper is afterwards parted. After being pressed a second time, it is taken to the drying room, where it is allowed to dry gradually. The size employed consists of any glutinous substance. A good size is made of the pieces of skins cut off in tanning, or of sheep's feet, by boiling them in a copper to a jelly. A certain portion of alum is added to the size, immediately before it is to be made use of.

*Finishing.*—The paper, when it has been thoroughly dried, is taken to the finishing-house, where it is twice put under the action of the press, then selected, examined, folded, made up into quires, and finally into reams. In general the whole operation is accomplished within three weeks. A good skin or surface, as it is called, is communicated to the paper by means of the press; and the fine smooth surface observable in writing-paper is given by hot-pressing. This operation is done by means of smooth pasteboards, between every one of which there is placed a sheet of paper, and between every 40 or 50 pasteboards a heated plate of iron.

*Of Machines.*—Various machines have been invented to improve the art of paper-making, the most important of which is Fourdrinier's machine, represented in Plate 150, and of which a full account may be found in the *Repertory of Arts,* Vol. xiii. Second Series. A is a vat, wherein there are two agitators to keep the pulp suspended; from this the stuff is convey through a sluice into *b*, and thence on to a web of wire-cloth *c c c c*, four feet wide and 24 long, the two ends of which are sewed together: This wire-cloth is stretched on several rollers, *k k k*; the part of it next the vat runs on various small level rollers; *m m* are two rollers above the wire-cloth. Below these passes an endless strap *b*, which returns over the rollers above, and which forms a ledge to confine the stuff while in a fluid state. One of these straps is at each side of the web. The part of the wire-cloth next the vat is shaken by means of a rod from an excentric wheel. The rollers being all set in motion, and the wire-cloth, with the stuff running on it, moving on towards *d*, the rod shaking it so as to make it part with the water, forms the stuff into paper; when it arrives at the rollers *d d*, it passes between them, undergoing a slight pressure; here the paper is laid on the web of felting *e e*, the two ends of which are likewise sewed together, and the web of wire-cloth returns below, as represented in the plate; the paper and felt are then pressed between the rollers, *f f*; when the paper arrives at *g*, it is detached from the felt and wound on the reel *h*, which, when it has 16 or 18 quires on it, is removed, and another reel, *i*, is substituted in its place, and the paper being cut off, the reel *h* is ready to be sent to be parted, and to be dried, sized, and finished, as has been already described. The passage of the paper from the vat to the reel is marked by dotted lines. So admirably is the machinery constructed, that no part can go too quick or too slow.

Machinery.

Machines to answer the same purpose have been invented by Dickson, Cobb, and Cameron; but, in point of expedition and extent of work Fourdinier's is excelled by none. That of Mr Cameron, in the neighbourhood of Edinburgh, is very well adapted for a small mill, and promises to become highly useful for making laid papers. This machine has common forms or moulds fastened in a frame having a revolving motion. As the moulds pass by a particular place, the pulp runs on them. The moulds, as they move along, accomplish the couching process, for which purpose they are made to run upon their face, which comes in contact with a revolving and endless web of felting; there they obtain a pressure, and in passing on they are again reversed to receive the stuff for another sheet.

Hitherto the use of the machine has been principally limited to the making of wove paper. Laid writing-papers continue to be manufactured by the hand, but for this purpose also machinery is now in use. Card-paper is made of a very firm stuff, and it should be well sized, so that when smoothed it may have a shining surface.

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We shall close this article with some account of *Paper-hangings,* which constitute an important article of manufacture in this country.

In the manufacture of the various kinds of paper-hangings, the chief difference lies in the grounds, some of which are laid in the common vehicles for water-colours, and some in varnish. Paper-hangings for rooms are made in imitation of brocades, damask, chintzes, velvet, &c.; and some kinds for covering ceilings or the sides of passages and stair-cases, are prepared in imitation of stucco-work. A peculiar kind of paper is employed for paper-hangings, which is necessarily stamped before being painted. Such colours as may be used in water and varnish may be employed for painting them. The method of making the common grounds laid in water, is to mix whiting with glover's size, which being laid with a brush in an even manner on the paper, does perfectly well when the ground is to be left white. The same plan must be pursued, and the ground of whiting first laid when coloured grounds are required. But in straw colours or pink, the mixing of some strong colour with the whiting will frequently obviate the necessity of a second coating. Paper-hangings are painted by printing on the colours, by using the stencil, or by laying them on with a pencil. When the first of these three methods is taken, the impression is made by wooden points, which are so made, that the figure to be expressed is made to project from the surface, by cutting off all the other part; and this being charged with the colours tempered with the proper vehicle, by gently letting it down on a block whereon the colour is previously spread, leads it from thence to the ground of the paper, on which, by means of its weight and the effort of the individual's arm who uses the print, it is made to fall more forcibly. There must of necessity be as many distinct papers as there are colours to be printed. Where there are more than one, however, the print must be let fall exactly on the same part of the paper as that which went before, that the figure of the design may not appear irregular or confused. One of the tables employed in the manufactories in this country, for printing the paper adapted for hangings, is represented in Plate 150. A is a water-tight box, named the sieve, raised upon legs; this box, which is of a square form, is one-fourth filled with water intermixed with paper-shavings, &c. after which another box being put into it, it floats on the water; on the bottom of this box, which is of parchment, a frame covered with a piece of felt is laid: The table where the printing is done has two pieces of wood, *a*, fixed upright in it; by means of notches in these pieces of wood, the end of a brass-wire is introduced, which is put through the middle of the roll of paper *b*; the paper from this roll goes over the edge of the table and is laid upon the horse, fig. 1. which has a roller on its top for the paper to lie upon. A number of small sticks *c*, somewhat longer than the width of the paper, are laid on one part of the horse.

The following is the method of conducting the operation: A roll of paper, usually 12 yards long, and 22 inches wide, is, by the workman, taken from the shelf under the table; a brass wire is put through it, when its ends are placed on the pieces *a*, as appears in the Plate; this done, the ends of the paper are drawn to the end of the table. Meantime, a boy called the *tier-boy*, who stands on the stool, brushes the felt which lies in the sieve with the colour used in the printing; the operator then takes up the block bearing the device to be printed, by putting his hand through the strap, nailed to the back of it, and presses its face on the felt in the colour sieve: owing to the water in the box A, the felt touches the block in every part, and takes colour equally over the surface of the block. The block is then removed, and laid upon the paper near the end of the table, when the workman takes up a mallet having a leaden head called the mall, which has a small shelf *d*, in his right hand, and gives the block two blows on the back of it to communicate the desired impression. The mall being now put down, the block, still retained in the left hand, is turned round to take colour at the sieve. The workman as he turns round to bring the block over the paper again, takes hold of the edge of the paper with his right hand, and pulls it forward the proper distance to print a second time; in laying the block down, he brings it to its proper place with his right hand, and then takes up the mall as formerly. He proceeds in this way till the end of the paper touches the ground, when the tier boy immediately lays it over the horse, fig. 1. and returns to his post at the sieve. The same boy goes again, when the middle of the paper almost touches the ground, and pulling it straight over the horse, lays it on the ground. The pieces being finished in this manner, the boy takes the pole, fig. 2. and puts one of the sticks already alluded to into the groove across its top, after which he puts the paper on the sticks, and lifts them all together to the cieling of the room, where he lodges the ends of the sticks upon a rack designed for the purpose; he afterwards takes down the pole, and puts up another stick in a different part, in order to hang up all the pieces on a few loops to dry. The use of the lever is found necessary to give the impression in such prints as are very full, or in prints in which there is much colour to lay on. Two of the legs of the table A B project some inches; between these, two bars are bolted, the middle of which is strengthened by an upright post, whose end is fastened to the ceiling. The shelf *d* has a piece put into it; the workman takes his colour and places the block on the paper, as before, only, instead of taking the mall from the shelf, he places the middle of the lever (whose end was under the bar, and the middle resting on the piece put into the shelf) over the block, and presses his weight on the outer end of the lever, slides his right hand to the middle of it, keeping his left at the outer end, and turns the lever on to the shelf, after which he raises the block to take colour as before.

The usual practice, in low-priced paper, is to print the outlines only, and lay on the rest of the colours by *stencilling*. By this method, which can be practised well enough by common workmen, the expense of cutting more prints is saved.

Stencilling, it may be observed, is a cheaper method than printing of performing coarse work. Without such attention and trouble, however, as render it equally difficult with printing, it is much less exact and beautiful in the effect, because the outlines of the spots of colour have not that sharpness which is given by prints; and by the original misplacing of the stencils, or shifting the place of them while the process is going on, deviations from the proper figure are very apt to occur. The following is the proper method of stencilling the colours: The figure which all the parts of any particular colour make in the design to be painted, is cut out in a piece of thin leather, or oil-cloth, which pieces of leather or oil-cloth are called *stencils*; and, being laid flat on the sheets of paper to be printed, spread on a table or floor, are to be rubbed over with the colour, properly tempered by means of a brush. As the colour passes over the whole, it is spread on those parts of the paper where the leather or cloth is cut away, so that the same effect is given as if laid on by a print. But this is only practicable in parts where there are merely detached masses or spots of colours. Where there are small continued lines or parts that run one into another, it is no easy matter to preserve the connection or continuity of the parts of the cloth, or to keep the smaller corners close down to the paper; hence, in such cases, prints are to be preferred.

In the imitations of India paper, and other nice work, pencilling is had recourse to. The manner of performing it is the same as in other paintings in water or varnish. Pencilling is used for forming or delineating some parts of the design, where considerable freedom and variety are required in the work; and sometimes it is used only to fill the outlines already formed by printing, where the price of the colour, or the exactness of the manner in which it must be laid on, renders the printing or stencilling less proper.

*Flock-paper.*—This is a kind of paper of recent invention, which is embossed by means of chopped cloth before receiving the flock; the paper designed for the purpose is made ready with a varnish-ground, with some proper colour. Some mosaic, or other small running figure in colours, is not unfrequently printed on the ground previous to the flock being laid on; and this may be done with any pigment of the colour desired, tempered with varnish, and laid on by a print accurately cut to that end. The flock is laid on in the following manner: A wooden print being cut for laying on the colour in such a way that the part of the design which is intended for the flock may project beyond the rest of the surface, the varnish is put on a block covered with the leather or oil-cloth, and the print is likewise to be used in the same manner to lay the varnish on all the parts where the flock is to be fixed. After being thus prepared by the varnish impression, the sheet is to be removed to another block or table, and to be strewed over with flock, which is afterwards to be gently compressed by any flat body, so that the varnish may take a sufficient hold of it. The sheet is next to be hung on a frame till the varnish be quite dry, when the superfluous part of the flock may be brushed off by a soft camel's-hair brush. Flock is prepared by cutting woollen rags, or pieces of cloth, by means of a large knife, or by means of a machine worked by a horse mill. Counterfeit flock-paper, though done at little expense, has, when properly managed, a similar effect to the eye that the real has. It is made by laying a ground of varnish on the paper, and having afterwards printed the design of the flock in varnish, some pigment of the same hue with the flock required by the design, but rather of a darker shade, being duly powdered, is strewed on the printed varnish, and produces nearly the same effect as real flock.

## PAP

PAPER MONEY, a term usually applied to bank bills, which, instead of gold and silver, pass currently in trade. The nature and advantages of this species of currency, the natural utility of which has been called in question by some, has been considered under Economy, Political, in this work. See also Dr Smith's *Treatise on the Wealth of Nations.*

PAPER-OFFICE, an office in the palace of Whitehall, wherein are lodged all the public writings, matters of state and council, proclamations, letters, intelligences, negociations abroad, and generally all dispatches that pass through the offices of the secretary of State.

PAPHOS, in ancient geography, a town of Cyprus, situated on the west coast of the island. It is now called *Baffa*, and is distinguished only by its magnificent ruins, and a few paltry houses. The vicinity abounds in minerals, among which are a beautiful variety of crystallized quartz, called Baffa diamonds. Amianthus, of a very superior quality, as flexible as silk, and perfectly white, is also found here. There was, in this town, a very ancient temple of Venus, where was an oracle which was consulted by Titus, in his way to compliment Galba upon his elevation to the empire. Of all the Christian buildings, only the church of St George now remains, in which service is performed by the Greek ministers.

PAPIER-MACHE, a substance composed of cuttings of white or brown paper boiled in water, and reduced in a mortar to a kind of paste, and afterwards boiled with a solution of gum arabic. The substance thus prepared is made, by means of moulds, into tea-boards, waiters, toys, and the like. It is done over when dry with a mixture of size and lamp-black, and then varnished.

## PAP

PAPISTS, an appellation derived to the Roman Catholics, in consequence of their acknowledging the Pope or bishop of Rome to be the supreme pastor of the universal church, and from their remaining in his communion; contradistinguishing themselves from *Protestants*, who are so denominated from protesting against his supremacy. The Papists profess to believe all the articles of the creed of Pope Pius; and they promise implicit obedience to the edicts of the church, particularly the decrees of the council of Trent. See Church, Popery, and Religion.

PAPON, John Peter, a distinguished miscellaneous writer, was born at Pujet, near Nice, in 1736. He was a priest of the congregation of the Oratory, and died at Paris in 1803. He was the author of an Ode upon Death, the Art of the Poet and the Orator, with an Essay on Education; Funeral Oration for Charles Emanuel III. king of Sardinia, 8vo; Travels in Provence, History of Provence; History of the French Government from the Assembly of the Nobles 1787 to the end of 1788, 8vo.; Memorable Epochs of the Plague, &c.

PAPUA, or New Guinea, a considerable island in Australasia, to the north of New Holland, from which it is separated by a strait. The centre of Papua is in east longitude 149°, and south latitude 5°. For a particular account of the Papuans, the reader may consult Captain Forrest's *Voyage to New Guinea* in 1774, 1775, and 1776; and Pinkerton's *Geography*, Vol. II. p. 631—647.

PAPYRUS, a remarkable reed, from which was made the celebrated paper of Egypt. Mr Bruce, who saw this plant growing both in Egypt and Abyssinia, informs us, that so far from any part of it being useless, the whole plant is at this day employed in Abyssinia for making boats, a piece of the acacia tree being put in the bottom to serve as a keel, like the ancient Egyptian boats. "The bottom root or woody part of this plant was likewise of several uses before it turned absolutely hard; it was chewed in the manner of liquorice, having a considerable quantity of sweet juice in it. This we learn from Dioscorides. It was, I suppose, chewed, and the sweetness sucked out in the same manner as is done with sugar-cane. This is still practised in Abyssinia, where they likewise chew the root of the Indian corn, and of every kind of cyperus; and Herodotus tells us, that about a cubit of the lower part of the stalk was cut off and roasted over the fire, and eaten. From the scarcity of wood, which was very great in Egypt, the lower part was likewise used in making cups, moulds, and other necessary utensils. One use of the woody part was to serve for what we call boards, or covers for binding the leaves, which were made of the bark;—we know that this was anciently one use of it." The papyrus has a head composed of long grassy filaments, with a stalk, which rises to the height of 10 or 15 feet, of a vivid green, and tapering from the root to the top. It has a triangular shape,—a form well adapted to break the violence of the wind, and diminish the pressure of the stream. From the name papyrus, the term paper, and from biblos, book, are derived. See PAPER-MAKING.

PAR, a commercial term signifying any two things equal in value. See EXCHANGE.

PARABLE, a relation founded on something real or apparent, from which a moral is suggested; such are the parables of Dives and Lazarus, of the Prodigal Son, and of the Ten Virgins. Parables constitute a part of allegory, and of these the prophetical writings are full. It was universally the mode," says Dr Blair, "throughout all the eastern nations, to convey sacred truths under mysterious figures and representations. See LANGUAGE.

PARABOLA, in geometry, is a conic-section arising from a cone being cut by a plane parallel to one of its sides, or parallel to a plane that touches one side of the cone.

PARACELSUS, AURELIUS, PHILIP THEOPHRASTUS BOMBASTUS, de Hohenheim, a celebrated physician, was born at Einfidlen, in Switzerland, in 1493. His father bestowed upon him a most liberal education; and he afterwards travelled into France, Spain, Italy, Germany, and other countries, to perfect himself in the knowledge of physic. On his return to Switzerland, he settled at Basil, where he soon became highly popular by his practice, in which he made use of two powerful medicines, mercury and opium, and acquired a great name by his successful treatment of the venereal disease. Paracelsus afterwards went into Alsace, where he was distinguished as an alchymist; and he pretended to have discovered not only the philosopher's stone, but the art of prolonging life by an elixir. He notwithstanding died poor in 1541. The best edition of his works is that of Geneva, 1658, 3 vols. folio. Some notice of Paracelsus has been given under MEDICINE in this work.

PARACENTRIC, a term applied to the motion or space by which a revolving planet approaches near to or recedes farther from the sine or centre of attraction.

PARACHUTE, a kind of umbrella, which Mr Blanchard, the French æronaut, invented for the purpose of breaking a person's fall from an air balloon, in case of any accident happening to the balloon at a high elevation. See ÆROSTATION.

PARADISE, the Garden of Eden, wherein Adam and Eve were placed immediately upon their creation. There have been numerous enquiries respecting its situation; but the exact place must ever remain undecided, considering the many changes that have taken place on the surface of the globe. The site of this terrestrial paradise is supposed by the learned Huetius to be upon the river that is produced by the junction of the Tigris and Euphrates, now named the river of the Arabs, between this junction and the division made by the same river, before it falls into the Persian sea. Some writers place it in Armenia, between the sources of the Tigris, the Euphrates, the Araxes, and the Phasis, which they consider as the four rivers mentioned by Moses. Learned men have laboured in vain in this vague and uncertain inquiry; for the Mosaic description of the situation of Paradise, it is evident, will not suit any place on the present globe. Mr Miln observes, that Moses "mentions two rivers in its vicinity, viz. Pison and Gihon, of which no vestiges can now be found. The other two still remain, viz. Hiddekel, supposed to be the Tigris, and the Euphrates, whose streams unite together at a considerable distance above the Persian gulph, in some part of which, it is highly probable, the happy garden once lay. The gulf is eastward both of the land of Midian and the wilderness of Sinai, in one of which places Moses wrote his history; but, since the formation of this earth, it has undergone great changes, from earthquakes, inundations, and many other causes. The garden, however, seems to have been a peninsula, for the way or entrance into it is afterwards mentioned. We are told that a river went out of it, which, according to some, should be rendered, *run on the outside of it*, and thus gave it the form of a horse-shoe; for, had the Euphrates run through the middle of the garden, one half of it would have been useless to Adam without a bridge or boat wherewith to have crossed."

Paradise is used to denote the place reserved for the habitation of the blessed after death; but the Christian paradise is more usually called heaven. The Mahometan paradise, described in the Koran, with all the wildness of Eastern fiction, is represented as being situated above the seven heavens, or in the seventh, and next under the throne of God. To express the amenity of the place, it is affirmed that the earth of it is of the finest wheat-flour, or of the purest musk or saffron, and that its stones are pearls and jacinths; the walls of its buildings enriched with gold and silver; and the trunks of all its trees of gold, amongst which the most remarkable is the tree *tuba*, or tree of happiness. This tree is said to stand in the palace of Mahomet, though a branch of it will reach to the house of every true believer, loaded with pomegranates, dates, grapes, and other fruits of extraordinary size and delicious tastes unknown to mortals. This tree is said to be so large that a person mounted on the fleetest horse could not gallop from one end of its shade to the other in one hundred years; and it supplies the blessed not only with fruit, but likewise with silk garments. Of the rivers of this paradise, which are represented as its principal ornament, some are said to flow with water, some with milk, some with wine, and others with honey; and all of them take their rise in the tree *tuba*. Besides these rivers, numerous lesser springs and fountains, whose pebbles are rubies and emeralds, their earth of camphor, their beds of musk, and their sides of saffron, water the garden of this paradise. Indeed the whole description, as contained in the Koran, is a tissue of the grossest absurdity.

PARADOX, a term derived from the Greek, and signifying an apparent *contradiction*, or a tenet contrary to received opinion, but true in fact. Geometry particularly abounds with paradoxes. That a right line, for example, should continually approach to the hyperbole, and yet never reach it, is a true paradox; and in the same manner a spiral may continually approach to a point, and yet never reach it in any number of revolutions.

PARAGUAY, a government of the viceroyalty of Buenos Ayres, bounded on the east by Brazil, on the west by Chili and Peru, on the south by Patagonia, and on the north by the river Amazon. This extensive country, which is divided into several provinces, appears to be mountainous to the north and north-west, but many parts of it are yet unexplored. It abounds in lakes and rivers; of the latter, the principal are the Paraguay and Parana, which, uniting, form the Plata.

The plains of Paraguay are remarkably fertile, producing cotton in great abundance, tobacco, and the herb called *matté*, or Paraguay tea, the infusion of which is drank in all the Spanish provinces of South America. There are likewise in this country a great variety of fruits, and rich pastures that feed great numbers of sheep, cattle, horses, and mules. A generous and healthy vine is produced here, but the roots are destroyed by the ants, which are prodigiously numerous. Many thousands of mules are annually sent from Paraguay to Peru. Among the other quadrupeds of this country, are the glama or lama, the guanoco, the macmoro, or chilihueque of the Chilese, the vicuna, and the paco or alpaco. The American tiger, or jaguar, is chiefly known in Paraguay and the forests to the north. The condor, the largest bird of the vulture tribe, is not unfrequent in the mountains towards Tucuman; and a species of ostrich is found in the wide plains. The various vegetable productions, and innumerable herds of cattle in Paraguay, render it very opulent. Of the botanical productions here, are the tree that bears the quinquina, or Jesuit's bark, the sarsaparilla, rhubarb, jalap, sassafras, the mangay, yielding the elastic juice applied in Europe to a variety of purposes, and the guayacum.

Paraguay was first discovered in the year 1526 by the Spaniards, who passed from Rio de la Plata to the river Parana in small barks, and thence entered the river Uraguay. The Jesuits being admitted to this fertile region in 1580, they, in the next century, founded the celebrated missions of Paraguay; which missions were a number of colonies, each governed by two Jesuits, one of whom was rector, the other his curate. Paraguay was not thoroughly reduced till the Jesuits obtained possession of it, but, in course of time, they effected an absolute dominion, both spiritual and temporal, over the natives. The court, however, expelled the Jesuits in 1767; and the natives were placed upon the same footing with the other Indians of the Spanish part of South America.

*Assumption*, the capital, stands in a fertile district on the river Paraguay. It has been already noticed. See ASSUMPTION.

PARALLAX, a term denoting variation or change, used by astronomers to signify the difference between the true and apparent place of a planet, which difference arises from the error of the sight at so vast a distance, and is less or greater in proportion as the star is nearer or more remote from the earth, the parallax being the difference between the place of any heavenly body as viewed from the centre and from the surface of the earth precisely at the same time. Thus, suppose a star in the sensible horizon seen by a spectator on the earth's surface at 55 north latitude, this star, if viewed at the same instant from the centre of the earth, would appear in the firmament considerably elevated above the horizon, in a position farther to the north, and this point, in which it appears, is called the true place of the phenomenon. A spectator on the earth's surface, at latitude 55, will see it at a certain point, termed its visible or apparent place, and the arch constituting the distance between its true and its visible place is called the parallax of the star. But suppose the star elevated northward ten, fifteen, or twenty degrees above the horizon of its former position, the true place as viewed from the centre of the earth will also be elevated; but the arch between its true and visible place, which is called the parallax, will be less than before, and the higher a star is elevated above the horizon, the less will be its parallax. The horizontal parallax, therefore, is the greatest; and should the star rise to the zenith, it could have no parallax at all, because it would appear in the same point whether viewed from the centre or surface of the earth. The more distant a star is from the earth the less will be its parallax; and, therefore, the parallax is the difference of the distance of a star from the vertex or zenith when viewed from the surface and from the centre of the earth.

If the distance of a planet from the earth be known, its parallax may easily be found; for, suppose a triangle formed by a line from the centre of the earth to the spectator, and by another line from the spectator to the planet, the right angle at the spectator having the semi-diameter of the earth, and a line from the centre of the earth to the planet, which is the distance of the planet, the angle thus formed, and which is called the horizontal parallax, is found by the rules of trigonometry; but having the parallax, the distance of the planet may easily be found, since, in the same triangle having the semidiameter of the earth from its centre to the place of observation, and also the angle formed by the line from the spectator to the planet, and another line from the planet to the centre of the earth, the distance between the centre of the earth and planet may easily be found.

Several ingenious methods have been devised by astronomers for ascertaining the parallaxes of the celestial bodies, that their distances from the earth may thereby be discovered. So very remote are the fixed stars, and even our sun and the primary planets, all excepting Mars and Venus, when in perigee, that they have no sensible parallax deserving of observation. The parallax of our moon, however, is very considerable, and in the horizon exceeds a full degree. To find the moon's parallax, observe when both its horns are in the same verticle circle during an eclipse, and then take the altitudes of both horns, the difference of these two altitudes when halved, and either subtracted from the greater or added to the lesser, will give the apparent altitude of the moon's centre, and the true altitude is equal or nearly equal to the altitude of the shadow's centre at the same instant. The shadow's altitude can easily be found from the place of the sun in the ecliptic and its depression under the horizon, which is equal to the altitude of the point of the ecliptic opposite, in which will be found the shadow's centre, so that, both the apparent and true altitude of the moon being thus obtained, the difference of these will be the parallax. As the parallax of the moon varies, astronomers have constructed tables to shew the horizontal parallax for every degree of its anomaly.

The parallax has precisely opposite effects to those of refraction, as it always makes the altitude of a phenomenon appear lower than when viewed from the earth's centre; and this may occasion a change of the latitude and longitude, and of the right ascension and declination of any phenomenon, which is called their parallax. The parallax then will increase the right and oblique ascension and diminish the descension, will likewise diminish the eastern part of the northern declination and latitude, and in the western will increase them, and, both in the east and west part, it will increase the southern, whilst the longitude will be increased in the east and diminished in the western part.

Parallax, annual, signifies the change of the apparent position of a planet, occasioned by its being seen in different parts of its orbit, while revolving round the sun. The annual parallax of the fixed stars, owing to their vast distance, is altogether imperceptible, whilst that of all the planets is very considerable. See Astronomy. Parallax of the earth's annual orbit is the difference between the position of the planet as viewed from the earth and from the sun at the same instant. Parallax, horizontal, is when the sun, moon, or other planets are in the horizon, which is the greatest of any; or it is the difference between the real and apparent position of any planet when it is rising or falling; and, therefore, the horizontal parallax may be defined to be the angle which the earth's semi-diameter subtends at that object. Parallax in longitude is the difference between the longitudes of the star when viewed from the sun and earth, and parallax in latitude is the difference between its latitudes. The angle of parallax is that which is made in the centre of the planet by two lines imagined to be drawn from the centre of that planet to the surface and centre of the earth. In Levelling, parallax signifies the angle contained between the line of the true and that of the apparent level. Parallax likewise is used to express the change of position in any object caused by viewing it in an oblique direction in respect to another object; and in this sense the minute hand of a watch or clock, when viewed obliquely, may be considered as having a parallax, and the difference between the instants when seen obliquely or directly, is called the parallax.

PARALLEL ROADS of Glenroy.—These remarkable appearances have been long the subject of investigation among naturalists to discover their origin and use. Some have maintained that they are artificial productions, while others, with more probability, assign them a natural origin. According to those philosophers who adopt the latter opinion, the parallel roads mark the height of the lake which occupied the valley, as it existed at different levels. It is to be hoped that a farther acquaintance with the general changes which the earth's surface has undergone, with the causes of them, and probably the future discovery of some analogies to these phenomena, will at length remove what remains difficult of explanation in the physical history of Glenroy, and of its parallel roads. These appearances are extremely interesting in a physical view, especially to geologists; and to the ordinary spectator, or to a lover of the picturesque, they are, from the singularity of their aspect, no less striking. They are, however, but little known to the numerous travellers who visit Scotland to enjoy the romantic and picturesque. The courses and positions of the rivers and valleys which are the seats of these appearances, may easily be traced by those who are possessed of a map of Scotland.

Glenroy, or King's Vale, lies to the south-east of Loch-Lochy. Along the bottom of this valley a small stream winds its course; and on the declivity of the mountains, about a mile distant from the river on each side of it, are observed what are denominated the parallel roads. Of these appearances the first account appeared in Mr Pennant's work, in a note. It was not, however, till the publication of the Statistical Reports that any farther account of them was given to the public. From the report of the parish of Kilmanivaig, in which they principally lie, drawn up by Mr Ross, the minister, we take the following extract, as affording a good idea of the opinions then entertained concerning them. "As there is nothing left upon record respecting the times when, the persons by whom, or the purposes for which these roads were constructed, we can only mention the common traditions regarding them. One is, that they were made by the kings of Scotland, when the royal residence was in the castle of Inverlochy, which is not above eleven miles from the nearest of them; and what gives an appearance of truth to this tradition in the opinion of those who maintain it is, that the construction of these roads was so vast an undertaking as could not be undertaken by any vassal or nobleman, however powerful. Another tradition, which is that of the natives, is, that they were made by the Fingalians, and under the name of the Fingalian roads they are still known in this country. They are likewise called the Cassan, that is, the Roads, by way of eminence. Of this the natives are convinced, from this circumstance, that several of the hills have retained, from time immemorial, the names of some of the heroes of Fingal, such as the Hill of Gaul, and likewise of Bran, the famous dog of Fingal, &c. Now the popular opinion cannot be considered as a direct proof of any opinion; yet we cannot help remarking that the original tradition, which in this case has always been invariable, gives a strong degree of credibility to the existence of such heroes, and renders it by no means improbable that these extraordinary roads have been the result of their labours. The purpose which they have been designed to serve seems to have been, agreeably to the common opinion, to facilitate the exercise of hunting; for in ancient times, and indeed till within this century, the valley was covered with wood, which made it very difficult to pursue the deer, &c. and rendered certain avenues necessary for effecting this purpose; in corroboration of which opinion, it may be observed, that on the sides of the roads there have been found some stakes fixed in the ground, probably the remains of some of the palings or fences which in those days were made use of to confine the game till they were driven in upon a field called Dal na Sealg, or Huntingdale, where the presumption is that they were killed."

At different periods, and independently of each other, the parallel roads were visited by Mr Playfair in company with Lord Webb Seymour, by Sir James Hall, and by the Earl of Selkirk, but no memoir was published by any of these observers. In 1814 Dr M'Culloch made a careful examination of the parallel roads, and a paper on the subject was then presented to the Geological society, and read in 1817. This paper afforded a satisfactory description of Glenroy, accompanied with the several necessary measurements, and with views, maps, and sections, and gave likewise a detailed view of the different theories which had been proposed to illustrate the phenomena, with arguments deduced from them proving these to be superficial and indistinct. A theory was at same time proposed in explanation of the appearances, which placed the subject in an intelligible point of view. To that paper, and to another by Sir Thomas Dick Lauder, in the Transactions of the Royal society of Edinburgh, published in 1821, from a survey made in 1817, we must refer the reader for a complete description of Glenroy and the parallel roads.

PARALLEL RULER, an instrument for drawing parallel lines. See Mathematical Instruments.

PARALLELS, in military affairs, are deep trenches from 15 to 18 feet in width, the use of which is to form a communication with the several points of attack, and likewise to serve as a shelter for the soldiers whose business it is to defend the workmen from the attacks of the enemy. These trenches were first employed by M. Vauban. See War.

PARALYSIS, the palsy. See Medicine.

PARAMOUNT, in law, the highest lord of the fee of lands, tenements, and hereditaments. There may be a lord mesne where lands are held of an inferior lord who holds them under certain services, and therefore the superior lord is lord paramount. The king is the supreme lord, or lord paramount, of all the lands in the kingdom. Sometimes this seigniory of a lord paramount is called an honour, and not a manor, particularly if it has been in the hands of an ancient feudal baron, or has belonged to the crown at any time.

PARANA, a considerable river, which takes its rise in the mountains on the west border of Rio Janeiro in Brazil. See Buenos Ayres.

PARAPET, or Breast-Work, in fortification, a wall on the outer edge of a rampart, serving to cover the soldiers and cannon from the effects of the enemy's fire. It is generally faced with masonry, and is from 18 to 22 feet thick and from seven to nine or ten feet high. In the parapet there are certain intersections from the top to within three feet of the platform, for the cannon to pass through; these are termed embrasures, and are distant from each other from 12 to about 16 feet. What is called the melon is that part of the parapet which is intercepted between two embrasures. Parapet is applied to that part of the exterior wall of a building that rises above the gutter, or above the lower extremities of the rafters, and is commonly crowned with a coping of stone. And the same term denotes any low wall or breast-work raised on the edge of a bridge or quay, to prevent people falling over.

PARAPHERNALIA, in the civil law, such goods, besides her dower, as a wife brings her husband, being principally her apparel, jewels, &c. which in the lifetime of her husband she wore as the ornaments of her person, to be allowed by the discretion of the court according to the quality of her and her husband. Unless there is some provision made in the marriage-contract to the contrary, these goods are still to remain at the woman's disposal, exclusive of her husband. If she continues in the use of them till his death, she shall afterwards retain them against his executors and administrators, legatees, and all other persons except creditors, where there is a deficiency of assets.

PARASELENAE. See Meteorology.

PARASITE, among the Greeks, was applied to a kind of priests or ministers, whose duty it was to take care of the corn set apart for the service of the temples and the gods. The parasites had even the intendance over sacrifices which they were careful to see duly performed. Parasite, though originally a very reputable title, is now used only as a term of reproach.

PARCÆ, in Heathen mythology, the three goddesses, Clotho, Lachesis, and Atropos, who were supposed to be intrusted with the management of the fatal thread of life. According to the fable, the distaff was held by Clotho, the thread was drawn by Lachesis, and it was cut by Atropos. The ancients imagined that the Parcæ used white wool for a long and happy life, and black for a short and miserable one. By Lucian they are represented as three poor old women, having large locks of wool mixed with daffodils on their heads, one of which holds a distaff, Parchment.

the other a wheel, and the third a pair of scissars. But by others Clotho is represented as appearing in a long robe of divers colours, wearing a crown upon her head, adorned with seven stars, and holding a distaff in her hand; Lachesis in a robe beset with stars, with several spindles in her hand; and Atropos clad in black, cutting the thread spun, with a pair of scissars. The Romans called them Nona, Decima, and Morta.

PARCHMENT, sheep or goat's skin prepared after a peculiar manner, which renders it proper for certain uses, especially for writing upon and for the covering of books. The term is derived from the Latin *Pergamena*, the ancient name of this manufacture, which it is said to have derived from the city Pergamus, and its invention is generally ascribed to Eumenes, king of that city, though he appears merely to have been the improver of parchment, and not the inventor; for, as Diodorus informs us, the Persians and others wrote all their records on skins long before the time of Eumenes, and it is not improbable that such skins were prepared and dressed after a manner somewhat similar to that of our parchment, though less artificially. Virgin parchment is a sort finer and thinner than the rest, made of the skin of an abortive lamb or kid, and employed for fans, &c. Parchment made of the skins of abortive calves, or at least of sucking calves, is denominated vellum, which is finer, whiter, and smoother than the common parchment. Parchment and vellum constitute a considerable part of the French commerce, being manufactured in most of their cities; and, besides the consumpt at home, vast quantities are sent abroad, especially to England, Flanders, Holland, Spain, and Portugal.

Parchment is thus manufactured: The skin, after it has been stripped of its wool, and placed in the lime pit, as described under Tanning, is stretched by the skinner on a kind of frame, preparatory to his paring off the flesh with an iron instrument. It is then moistened with a rag; and powdered chalk being spread over it, the workman takes a large pumice-stone, flat at bottom, and rubs over the skin, by which means the flesh is scoured off. This done, he goes over it again with an iron instrument, moistens it as before, and rubs it with the pumice-stone, without any chalk underneath, in order sufficiently to smooth and soften the flesh side, after which he drains it again by passing over it the iron instrument as formerly. When the flesh side has been drained by scraping off the moisture, the iron is in the same manner passed over the wool or hair side; he next stretches the skin on a frame, and again scrapes the flesh side, which completes the draining or purifying process. More chalk is now thrown on by the skinner, and swept over with a piece of lamb skin having the wool on, by which means it is still farther smoothed. The skin must afterwards be left to dry. When sufficiently dried, it is taken off the frame, by cutting it all round. Thus prepared by the skinner, the manufacture remains to be completed by the parchment-maker, who first, while the skin is dry, pares it on a summer, that is, a calf skin stretched in a frame, with an instrument rather sharper than that employed by the skinner; and working with the arm from the top to the bottom of the skin, he takes away about one-half of its thickness. Having been in this manner equally pared on the flesh side, the skin is again rendered smooth by its being rubbed with the pumice-stone on a bench covered with a sack stuffed with flocks, and thus the parchment is at length brought to a fit condition for writing upon.

Parchment.

PARDON, in criminal law, implies the remitting or forgiving an offence committed against the king or the laws. The king possesses the power of pardoning criminals, or of remitting a severe punishment, on the condition of the criminal submitting to a milder one. The king can grant the royal pardon at pleasure for any species of offence, or he can change the punishment of death into transportation; but he cannot add to the severity of a punishment. A pardon may be conditional, or the king may extend his mercy upon what terms he thinks proper. A pardon by act of Parliament, it may be observed, is more beneficial than by the king's charter, for a man is not bound to plead it; but the court must *ex officio* take notice of it: neither can he lose the benefit of it by his own negligence, as he may of the king's charter or pardon. Pardons are obtained by petitions to the king, which formerly used to be presented to the royal person, and the right to present which to the king's person is secured by the bill of rights. But, by a modern regulation, all petitions must be left at the secretary of state's office, and an answer called for at that office.

Pardons, in the opinion of some theorists, should be excluded in a perfect legislation, where punishments are mild but certain; because, say they, the clemency of the prince seems a tacit disapprobation of the laws. But the exclusion of pardons must necessarily introduce a very dangerous power in the judge or jury, namely, that of construing the criminal law by the spirit instead of the letter, or it must be holden, what no man will seriously avow, that the situation and circumstances of the offender, though they alter not the essence of the crime, ought to make no distinction in the punishment. This power of pardon, however, cannot subsist in democracies, where nothing higher is aknowledged than the magistrate by whom the laws are administered; and it would be impolitic for the power of judging and of pardoning to centre in one and the same individual. This, as Montesquieu remarks, would oblige him very often to contradict himself, to make and unmake his decisions. It would tend to confound all ideas among the mass of people, us they would find it difficult to tell whether a prisoner were discharged by his innocence, or obtained a pardon through favour. But, in monarchies, the king acts in a superior sphere, and though he regulates the whole government as the first mover, yet he does not appear in any of the disagreeable or invidious parts of it. Whenever the nation see him personally engaged, it is only in works of legislature, munificence, or compassion. The people, therefore, look up to him as the fountain of bounty and grace; and these repeated acts of goodness, coming immediately from his own hand, endear the sovereign to his subjects, and contribute more than any thing to root in their hearts that filial affection and personal loyalty which are the sure establishment of a prince. " Pardon," another able writer observes, "is that act of his government which is the most personal and most entirely his own. The king condemns no man; that rugged task he leaves to his courts of justice; the great operation of his sceptre is mercy."

PARGA, a maritime town of Albania, situated not far from the mouth of the ancient Ancheron, in east longitude, 20° 39′ and north lat. 9° 22′. It is surrounded with walls, and has a double harbour formed by a small island. When, in 1819, this place was given up by Ali Pacha, the greater part of the inhabitants, who were Albanian Greeks, removed to the Ionian islands. Population 8000.

PARHELIA are meteors formed by the rays of the sun reflected from the surface of a cloud. They exhibit all the beautiful colours of the rainbow, the red and yellow being on the side towards the sun, and the blue and violet on the other: many of them have a long shining tail opposite to the sun, and some have been observed with two or three tails. Their apparent size is the same as that of the sun; but they are not always round, nor always so bright as the sun; and when several appear at the same time, some are more bright than others. See Meteorology.

PARIAN CHRONICLE. See Arundelian Marbles.

PARING and BURNING. See Agriculture.

PARIS, the capital of France, is situated on a plain on both sides of the river Seine, which here flows in a direction nearly from east to west. It is about 260 miles south by east of London, in north latitude 48° 50′, and east longitude 2° 20′ 15″. Its original name, as stated by Cæsar, was Lutetia, a word supposed by some to have been derived from the Latin *lutum*, mud, alluding to the marshy nature of the ground whereon the city is built. The present name of this great metropolis was unquestionably derived from the Parisii, who anciently occupied that district in which Lutetia stood, though at what period this modern appellation came into general use, is not satisfactorily ascertained.

*Form and Extent.*—Paris is nearly of a circular form, and, including the suburbs, is about 14 English miles in circuit. London, with its suburbs, stretches over a much larger surface. The French capital, however, is much more compactly built, contains loftier houses, and is more closely inhabited. In 1817, the population of Paris amounted to 715,000, being equal to about two-thirds of that of the British metropolis. The adjacent country presents but little diversity of aspect, exhibiting the ordinary features of a rural and sequestered district. The neighbourhood of Paris is not enlivened with pleasure-grounds, gardens, or villas, consequently the traveller enters immediately from the solitary roads of the country into the noise and bustle of the city. On one side, however, the approach is remarkably attractive. From the bridge of Neuilly, on the road from St Germains, a fine avenue of trees, skirted on either side by elegant houses and gardens, stretches for a mile and a-half in a direct line to the gates of the city, and affords a prospect of some of the more splendid buildings of Paris.

The *climate* of this city is considered salubrious. The mean temperature is 51°.08 of Fahrenheit. The winter is rather colder than in London, but shorter; the summer is a good deal milder, and the weather in general less changeable.

*Divisions, &c.*—Paris is divided into the *cité* which lies in the centre,—the *ville* in the north, and the *université* in the south. The subordinate divisions being designed merely to facilitate the administration of justice, need not be here specified. In this description are included the Fauxbourgs of Paris, buildings of considerable extent, situated between the Boulevards and the new wall, and still retaining their individual names. With the exception of the public edifices, which are numerous, and the new streets, this city has not a very attractive aspect to the stranger. It contains no long lines of buildings such as are in London, and especially in Edinburgh, of equal dimensions and of the same fashion of architecture. In general, the streets are narrow, crooked, and ill paved, and every thing like regularity seems to have been avoided. A humble mansion frequently appears beside a spacious edifice; a superb gateway is sometimes found to lead into a paltry court; and what is equally unpleasing to the stranger, not a few of the finest houses front inward, or are concealed from the view by a high wall. But the Fauxbourg of St Germain exhibits the finest streets in Paris, while the Boulevards, a street occupying the space where the ramparts of the city were placed at a period when its circuit was not more than seven miles, is surpassed by no street in Europe. The Boulevards is in general about 200 feet in width, and the road in the centre is flanked on each side by rows of stately trees, with gravel walks for the accommodation of foot passengers. The magnificent lines of buildings in this spacious street, together with the continued bustle and animation, forms a remarkably interesting picture. There are in all about seventy squares in Paris, which, though in general neither large nor elegant, have a very enlivening effect. The largest and finest of these squares is the Place Vendome. The most handsome are the Place Royale, the Place des Victoires, the Place du Carousel, the Place de Louis XV. In the centre of the Place Vendome there is a pillar erected by Bonaparte in honour of his successes in Germany.

*Public Buildings.*—In the number and magnificence of its public buildings, the great attraction of the French metropolis consists. The palace of the Thuilleries, the present royal residence, begun in 1564, has a grand appearance, though its architecture is various and not the most chaste. The length of this venerable structure, including the pavilion at each end, is more than 1000 feet. Some fine specimens of ancient and modern sculpture are contained in the portico of the Thuilleries and in the garden attached to it. The Louvre, the oldest royal palace connected with Paris, is situated about a quarter of a mile from the Thuilleries, to which it is in fact united by what is called the gallery of the Louvre. The portion of this palace now denominated the Old Louvre, was begun under Francis I. The greater part of the Louvre, however, including the celebrated collonade, was constructed in the refined age of Louis XIV. This palace, which altogether forms a perfect model of architectural splendour, is of a quadrangular form, with an inner-court of 400 feet square. Unfortunately the narrowness of the open space in front, and the mean structure with which it is surrounded, weaken the striking effect which it is so well calculated to produce. "It is impossible," says a judicious traveller, "for language to convey any adequate idea of the impression which this exquisite building awakens in the mind of a stranger. The beautiful proportions and fine symmetry of the great façade, give an air of simplicity to the distant view of the edifice, which is not diminished on a nearer approach by the unrivalled beauty of its ornaments and detail; but when you cross the threshold of the portico, and pass under its noble archway into the inner court, all considerations are absorbed in the throb of admiration, which is excited by the sudden display of all that is lovely and harmonious in Grecian architecture." This interesting edifice, which was the theatre of so much slaughter on Bartholomew's day, (see FRANCE,) is now used as a museum of painting and sculpture. The Luxemberg is more elegant than the Thuilleries, though not so large; one of the apartments of it now forms the Chamber of Peers. This palace is of a square form, with an ample portico in the centre, and the principal building is surmounted by a noble pavilion which terminates in a dome composed of the Doric and Ionic orders. On the Seine is finely situated the Palais Bourbon, where the legislative body under Bonaparte held their sittings, and where the Chamber of Deputies now meet. The front of the Palais Bourbon is adorned with twelve Corinthian pillars, which support an entablature bearing, until the return of the present royal family, the inscription *A Napoleon le Grand*, and containing a bas relief to his honour, executed in a masterly style. The Palais Royale, which forms an oblong square, the area of which is paved and adorned with trees, is not deficient in elegance and taste; the façade, which was erected in 1781, is adorned with Doric and Ionic pillars. It is now more remarkable as a place of business and recreation than as the remains of a royal residence. The first floor of the building is occupied chiefly with shops devoted to luxuries of every description; the second floor is inhabited by private families, and likewise contains coffee-rooms, reading-rooms, apartments for public exhibitions, and for the meetings of literary societies. The arcades surrounding the Palais Royale are frequented during the day by men of business, by strangers, by the gay and the fashionable, and at night by the profligate and the sensual. Adjoining to the palace, there is an extensive garden terminated at either end by beautiful shruberries. Our limits will not permit us to describe the Garde Meuble, or the depôt of the jewels and furniture of the crown, the Palace of the Legion of Honour, the Institute, the Military School, the Royal Printing-House, the Mint, or Hôtel des Monnoies, the Hotel de Ville, the Palais de Justice, and other public buildings. The churches of Paris are extremely numerous but they are not superior to those of the English metropolis in point of size and magnificence. Those of Notre Dame and the Pantheon are the two most important, but are confessedly inferior to St Paul's in London. Notre Dame, the metropolitan church, is situated in the city, and rises to a great height above the surrounding houses. It is not constructed in the finest style of architecture. Its characteristic feature is massy greatness, so that it strikes the beholder more from its vast size than from the beauty of the proportions in which it is formed. The venerable and sombre aspect of this church affords a striking contrast to the airy brilliancy of the modern edifices of the city. The church of St Geneviève, called the Pantheon, besides being used as a place of public worship, serves as a place of sepulture for the great. Its portal, in imitation of that of the Pantheon at Rome, consists of a superb peristyle of twenty-two Corinthian columns, each of which is five feet and a-half in diameter and fifty-eight feet in height. The front of this church is decorated with sculpture and colossal figures. The only other churches in Paris particularly deserving of notice are those of St Sulpice, St Eustache, and St Roche. There are four Protestant places of worship in this city, all of which were originally Catholic edifices. Of these the most considerable is the church of the Oratory.

*Hospitals.*—Paris contains numerous hospitals and charitable institutions, some of which are devoted to the sick and others to the indigent. The Hospital de la Saltpetriere, is a foundation where 7000 females are provided for, and live under the inspection of sixty sisters. To this noble foundation belongs the castle of Bicestre, defended on all sides by a wall of considerable circuit, and which includes many large buildings, and several open places, and here 4000 males are supported. The Hospital de la Pietie, where poor children are maintained and educated, likewise forms a part of the Hospital-general. To these three foundations, with the Hotel Dieu, belong one common fund, amounting annually to more than 2,000,000 of livres. The Hotel des Invalides, erected by Louis XIV. for the accommodation of wounded and superannuated soldiers, is a building remarkably well suited to the objects to which it is devoted. An hospital for gratuitous vaccination is continually open for the treatment of the cow-pox, and the distribution of the matter to all parts of the kingdom.

*Triumphal Structures.*—Among its various ornaments, Paris has several triumphal monuments. The column in the centre of the Place Vendome, designed to commemorate Bonaparte's victories in Germany, merits particular notice. It is built in imitation of Trajan's pillar at Rome, and is twelve feet in diameter and 140 in height. It is adorned with a number of brazen figures in bas-relief, the materials of which were obtained by melting the cannon taken at Ulms and Austerlitz. These figures, each three feet in height, occupy the whole pillar, proceeding in a spiral direction from the base to the entablature. In a conspicuous part of the building was sculptured the name of *his majesty Napoleon*, and on the summit of it there was a statue of this great man grasping the imperial sceptre. The pillar, however, now terminates in a gallery and dome, the inscription and statue having been destroyed since the return of the present royal family. The triumphal monument erected by Napoleon in the Place du Carousel, was originally surmounted by the figures of Venetian horses and the car of Victory; but the allied powers, when they obtained possession of Paris, were careful to deface these ornaments and the bas-reliefs illustrative of his victories over the Prussians. Of the older monuments, the principal are the porte or gate of St Denis and that of St Martin, both of which may be regarded rather as triumphal arches than gates of the city. The porte of St Denis, which is 72 feet respectively in height and in width, is a piece of substantial architecture, the grand appearance of which is materially enhanced by the figures in bas-relief commemorative of the success of the armies of Louis XIV. and by the other decorations sculptured upon it.

*Bridges, &c.*—The Seine at Paris is only about half the width of the Thames at London. Havre de Grace, at the mouth of this river, may be considered as the harbour of the French capital, and the communication between this place and Paris is chiefly effected by land carriage. But though at Paris it is during summer adorned by nothing meriting the name of shipping, its banks, or quays, as they are called, which are built of stone, are of great extent, and form one of the most agreeable walks about the city, and its bridges have a very fine appearance. The largest and oldest of the bridges is the Pont Neuf, containing twelve arches. The Pont Royal and the Pont de Louis XVI. both consist of five arches. Of the bridges erected in the time of Bonaparte, the Pont de Jena, or des Invalides, and the Pont d' Austerlitz are the most considerable.

*Catacombs, &c.*—Till of late years, Paris was not very amply furnished with cemeteries; but by the interference of the government two extensive burial-grounds, in retired situations beyond the walls, have been opened, one for the northern the, other for the southern division of the city. During the past century, the catacombs have been considerably extended. All the bones that could be collected in the ancient cemeteries within the city, have been removed so the catacombs, and the sites of these cemeteries are at length occupied as squares or market-places. The catacombs,—subterraneous quarries whence the city was built, and by which a great part of it is undermined,—constitute one of the most striking objects in the French capital, and contain the remains of several millions of human beings. Along the sides of the different passages, some of which are a mile or two in length, human bones, carefully cleaned, are regularly piled. It may be proper here to notice the Musée des Monumens Français, which is a collection (begun in 1790 when the property of the church was confiscated for the use of the nation) of sepulchral monuments from the ancient cathedral of St Denis in the neighbourhood of Paris, and from other parts of the kingdom. For the purpose of illustrating the progress of the art to which they refer, these monuments are arranged according to their respective dates. Under one roof are collected (with what propriety the reader may judge) the monumental relics of philosophers, statesmen, and poets, the prospect of which must excite the most serious emotions.

*Trade and Manufactures.*—The staple manufactures of Paris consist principally of articles of taste, and all kinds of fancy works, such as jewellery of every description, watches, artificial flowers, and toys. In some species of manufactures it is perhaps unrivalled. The tapestries, called *Gobelins*, from a person of the name of Gobelin, who, in the middle of the 16th century, instituted this branch of manufacture are of the richest kind, and exhibit imitations of flowers or pictures, or commemorate some remarkable incident in history. Of these tapestries Lady Morgan observes, that the glow of colouring, fidelity of outline, and delicacy of truth, which characterize them, rival the most masterly touches of the pencil. This manufacture is a national concern, conducted at the public expense, and the chief consumption consists in the government itself,—the walls of the royal palaces of France being adorned with it, and presents of it made to the allied sovereigns of the nation, and to foreigners of distinction. Other manufactories besides that now alluded to are conducted at the expense of government. These are carpets, porcelain, and glass, of the most exquisite workmanship, but so very high priced that they cannot meet with general sale. The whole printing and bookselling business of France is monopolized by Paris. There are no fewer than 250 presses in the royal printing-office; and, according to Mr Pinkerton, there are four hundred respectable booksellers in the French capital, and the total number of those who actually acquire a livelihood by this profession cannot be estimated at much below three thousand. Havre de Grace, (already described in the order of the alphabet,) may be regarded as the harbour of Paris. The exports consist of manufactured commodities, and the imports of articles essential for the consumpt of the inhabitants.

*Police.*—The police in the metropolis of France is brought to great perfection, and every individual is watched as assiduously as if he were suspected of the grossest crimes. The smallest journey cannot be undertaken without a passport, and the name, profession, &c. of the numerous strangers who visit Paris are from their passport inserted in the police books. The department of the Seine, consisting of the capital and a small portion of the surrounding country, is governed by a prefect, under whom there are twelve mayors, one for each division of the city, and two other substitutes who manage the landward district. The jurisdiction of the courts of Paris extend no farther than to the seven neighbouring departments.

*Literary Institutions.*—The literature and literary institutions of the French capital are much celebrated. Much to the credit of the government the royal press of France was at a former period situated in the palace of the Louvre. The high character for printing which Paris early attained, it has not failed to support. At present the number of periodical and other works is unusually great. Among the literary institutions of this capital are the Université Royale, the oldest establishment of this kind in France, the

College Royale, the Ecole Polytechnique, the Institute, or Royal Society, (see INSTITUTIONS,) and the Bureau des Longitudes. In the Jardin des Plantes there are thirteen classes for botany and the various subjects connected with natural history. Four Lycées, or great public schools for elementary instruction are established in Paris; and there is an academy termed L'Ecole Royale des Beaux Arts, devoted to architecture, painting, and sculpture. In every part of France, but especially in the metropolis, private academies are very numerous. It may justly be remarked, that with Frenchmen of all ranks learning and talents are the objects of the greatest respect.

*Libraries, Museums, &c.*—The libraries of Paris are numerous and extensive; besides which, the number of public reading rooms, and of circulating libraries, is very considerable. The Royal library, instituted so early as the 14th century, has gradually increased in size and importance, and now contains 380,000 volumes, 80,000 manuscripts, with 5000 volumes of engravings; and, among other curious documents, it contains the original letters of Henry VIII. to Anna Boleyn, brought thither from the Vatican. This library is conducted on the most liberal principles, so that people of every class and rank, as well as strangers, find easy access to it. The advantages of a library are enjoyed by almost all the eminent schools and literary institutions. The libraries of the Institute and the Pantheon consist either of collections in general literature, or in some particular branch of science, according to the establishment to which they severally belong.

The collections of works of art, and of subjects connected with natural history, are particularly worthy of notice. During the sway of Bonaparte, the Louvre became possessed of every celebrated specimen of sculpture and of painting that could be obtained on the continent of Europe, and to it were brought all the works of genius and art which distinguished the various countries overrun by his armies. Though the Louvre has been, since the return of the Bourbon family, stripped of all the works which it had in this way amassed, a grand collection yet remains. The ground floor of the Louvre is occupied with statues and other specimens of sculpture arranged in a judicious manner. A superb staircase leads from this apartment to the gallery of paintings, which is 1400 feet in length, and contains 1200 paintings, some of them the works of the most eminent masters. To a stranger the first view of this magnificent collection of paintings is singularly grand and imposing. The museum of the Jardin des Plantes, or Royal garden, is extensive and important. In the geological and fossil departments it is unrivalled, and of the animal remains of the antediluvian world it contains some very remarkable specimens. The garden itself is laid out with great taste, and contains a great variety of plants from almost every region of the globe. In the buildings belonging to it, there is a large menage, comprising animals of every climate and latitude. Inseparably connected with the Jardin des Plantes, are the names of Jussieu, Buffon, Haüy and Cuvier. Excellent collections in natural history, antiquities, and painting are contained in the Pantheon. Among the other institutions of a similar nature in Paris are the Musée d'Artillerie, and the Conservatoire des Arts et Métiers.

*History.*—The inhabitants of Lutetia were a bold and resolute people, who, rather than allow their city to fall into the hands of the enemy, chose to consume it to ashes. A new city was notwithstanding built by Cæsar on the site of the old, and the Romans continued in the possession of it more than 500 years. The Franks took possession of it in the year 486; and early in the subsequent century they established it as their capital. The streets were paved, and the town surrounded by a wall in the twelfth century. During the reign of Louis XIV. more than 80 streets were opened and built, 33 handsome churches were erected, the quay was newly constructed, and four new ports were formed; the Hôtel des Invalides and the Observatory were founded; the Louvre was repaired and enlarged; the Boulevards were levelled and planted, and many other improvements were happily effected. Indeed the long and glorious reign of that monarch forms the most remarkable æra in the history of Paris. His successors, especially the unfortunate Louis XVI., were animated with the same spirit, and consequently Paris has gradually increased in size and elegance; nor have its interests been neglected since the revolution. In the time of Bonaparte, the metropolis of France made many acquisitions. See Pinkerton's *Description of Paris*, 2 vols.; Lady Morgan's *France*, 2 vols. *Paris, and Paris Revisited*, by John Scott; Mercier's *Picture of Paris*; and Rough's *Sketch of Modern Paris*.

PARIS, MATTHEW, an English historian, was a monk of the order of Benedictines at St Albans, and flourished in the 13th century. He was a man of general knowledge and integrity, and was employed in reforming the monasteries, which service he discharged with wisdom and zeal. His chief work is an History of English Affairs, from the Conquest to the 43 of Henry III. Many contradictory accounts have been given of him; but all agree that he possessed extraordinary abilities for the time in which he lived. Though his style as a writer is unpolished, that defect is obviated sufficiently by his integrity as a historian.

PARIS, PLASTER OF, plaster-stone, gypsum, or alabaster. See *Mineralogy*, under GEOLOGY.

PARISH, PAROCHIA, the precinct of a parochial church, or a circuit of ground occupied by the people belonging to one church. There is no positive information extant of the first division of parishes; but in the early ages of Christianity in this island parishes were unknown, or at least signified the same that a diocese at present does. According to Camden, England was divided into parishes about the year 630 by Archbishop Honorius. It is affirmed by Henry Hobart, that the council of Lateran, held A. D. 1179, first erected parishes. Mr Selden, however, endeavours to prove, that the clergy lived in common, without any division of parishes, long after the time to which Camden refers; and from the Saxon laws, it seems probable that long before the council of Lateran in 1179, parishes were in existence. In the laws of King Edgar, about the year 970, the distinction of parishes occurs. Judge Blackstone, in his Commentaries, observes, that it seems pretty clear and certain the boundaries of parishes were first ascertained by those of a manor or manors, because it very seldom happens that it extends itself over more than one parish, though there are often many manors in one parish. The lords, as Christianity spread, began to build churches upon their own demesnes or wastes, in order to accommodate their tenants in one or two adjoining lordships; and, that they might have divine service regularly performed therein, obliged all their tenants to appropriate their tithes to the maintenance of the one officiating minister, instead of leaving them at liberty to distribute among the clergy of the diocese in general; and this tract of land, the tithes of which were so appropriated, formed a distinct parish; and this accounts for the frequent intermixture of parishes one with another; for if a lord had a parcel of land detached from the main of his estate, but not sufficient to form a parish of itself, it was natural for him to endow his newly erected church with the tithes of such lands.

Camden reckons 9284 parishes in England, and Chamberlayne makes 9913. They are now generally reckoned about 10,000.

PARISH-CLERK, an officer in every parish, who is appointed for life by the minister, unless it be customary for the parishioners or church-wardens to choose him; in which case the canon cannot abrogate such custom. At first the business of parish-clerks was to officiate at the altar, for which service they enjoyed a competent maintenance by offerings. They are now laymen, and have certain fees for their support.

PARK, Mungo, the most enterprising, and on the whole the most successful, of the travellers who have attempted to explore the banks of the Niger, was born in 1771, at the farm-house of Fowlshiels, near Selkirk. At the grammar-school of that town he commenced his classical studies; and, after spending three years with Mr Thomas Anderson, a respectable surgeon, he at the age of 18 went to the university of Edinburgh, where during three successive winters he prosecuted his medical studies, and at same time found leisure to cultivate the study of natural history. Indeed, his peculiar attachment was to the science of botany, which was perhaps first induced by the example of his brother-in-law Mr James Dickson, who, in consequence of his eminence in this science was fortunate in obtaining the patronage of Sir Joseph Banks.

After the completion of his medical studies, Mr Park repaired to London to seek employment in his profession; and through the instrumentality of his excellent friend Mr Dickson, he was introduced to Sir Joseph Banks, who kindly promoted his views by obtaining for him the appointment of assistant-surgeon on board the Worcester East Indiaman. Owing to this appointment, he in 1792 made a voyage to Bencoolen in the island of Sumatra, where he collected a variety of specimens in natural history. He returned the following year; and in November 1794 he communicated to the Linnæan society a paper containing a description of eight new species of fishes from Sumatra, which was afterwards printed in their *Transactions.* At the suggestion of his patron Sir Joseph, Mr Park was, about this period, introduced to the members of The Association for promoting Discovery in Africa, as a fit person to undertake a journey to the interior of Africa; and as the Association were then looking out for an individual qualified to supply the place of the unfortunate Major Houghton, our adventurer was gladly accepted of. Mr Park accordingly sailed from Portsmouth on the 22d May 1795, on board the Endeavour, an African trader, and arrived on the north bank of the Gambia on the 21st of the following month. Of the expedition which followed, the hardships he encountered, and the discoveries which crowned his indefatigable exertions, some account has been given under the article Africa in this work. After an absence from Britain of two years and seven months, Mr Park arrived at Falmouth on the 22d December 1797. From Falmouth he immediately repaired to London, where he arrived before day-light. It is not unworthy of remark, that rather than disturb his brother-in-law Mr Dickson's family at an unseasonable hour, Mr Park chose to walk about for an hour or two; and happening to find the door of the British Museum gardens open, he entered in order to beguile the tedious moments. Here he had remained some considerable time, when Mr Dickson, who had the charge of the gardens committed to him, arrived at his post, and was agreeably surprised to find his valued friend in so very strange and unexpected a manner.

By the Association the return of Mr Park was regarded as a kind of triumph, because he had in some measure realized their hopes and projects; and no ordinary impatience was expressed by the public for the appearance of his Travels. Having effected his arrangements in the metropolis, our traveller returned to Fowlshiels, where, in the bosom of domestic affection, he assiduously applied himself to the preparation of the volume he was bound to publish, and which first appeared in the spring of 1799. Respecting the share which Mr Bryan Edwards, the historian of the West Indies, had in preparing this work for the press a question has been started. But, from the evidence adduced, the assertion that it was almost entirely composed by him appears to be unfounded, though he unquestionably rendered material assistance to Mr Park. (See Edwards, Bryan.)

After the publication of his travels, which excited universal interest, he married the eldest daughter of Mr Anderson of Selkirk, his former master; a union that added very much to his felicity, for the short period during which he enjoyed it. When a second expedition was proposed by the British government, Mr Park was very naturally selected as a most fit person for the undertaking; and it is not surprising that he was perfectly prepared to enter anew upon the career wherein he had already admirably distinguished himself. In the autumn of 1803 he was instructed to repair to London for the purpose of receiving a proposition from Lord Hobart, regarding the intended enterprise. On his arrival in the metropolis he was appointed to sail in the month of February 1804, but owing to changes in the ministry this order was countermanded, and he did not set out till the 30th January 1805. The result of this expedition proved extremely unhappy; and no reasonable hope can now be entertained that Mr Park has not in some way or other perished in his voyage down the Niger. See AFRICA, Vol. I. p. 85.

In 1815 was published the only memorial of Mr Park's second journey, namely, the notes sent by Isaaco from Sansanding, together with Isaaco's own journal; but the information thus afforded is meagre and unsatisfactory. Indeed, the faithful, though rapid sketches of this work, induce impressions rather unpleasing, though the character of Park must certainly rise in the reader's estimation from the perusal of the whole. His amiable qualities, and manly fortitude, are exhibited under circumstances peculiarly distressing; and we are shocked with the prospect of extreme wretchedness endured, with scarcely any advantage to recompence it. A striking combination of mildness and energy appeared in the character of Park; and while the loss of a person so useful as he was calculated to be, is deeply regretted by the friends of geographical discovery, his untimely fate cannot fail to be deplored by the admirers of human worth. So excellent was his character, both in public and private, that to the age and the country which gave him birth he was a distinguished ornament. See Park's *Travels*, first and second parts, and the *Life* prefixed to the latter.

PARK, a portion of ground surrounding a mansion or residence. Deer or other smaller animals are usually contained in such parks, and add materially to the forest scenery. The parks of Blenheim, Donnington, Croom, and Hagley, are among the most remarkable for beauty and extent in this kingdom. The term park originally applied to a large quantity of ground enclosed and privileged for wild beasts of chase by the king's grant or prescription. There were three things required to a park, namely, a grant thereof; enclosures by pale, wall, or hedge; beasts of a park, such as the buck, doe, &c. Where all the deer were destroyed, it was no more accounted a park; for a park consists of vert, venison, and enclosures; and if it was determined in any of them, it was a total disparking. To the common law are subject parks as well as chases, which, however, are not governed by the forest laws.

PARKER, RICHARD, a mariner who was the chief of the mutineers at the Nore in the year 1797. He was a native of Exeter, and had received a good education, after which he entered into the navy, and became a midshipman, but was broke for some misdemeanour. Being possessed of a good address and considerable fluency of speech, he was appointed principal of the delegates when the seamen rose on account of their wages and prize-money: on which occasion he took upon himself the command of the fleet, and was denominated Admiral Parker. For some time this enterprising individual ruled with great authority, to the alarm of the nation; but when the insurrection was suppressed, he was tried and executed on board the Sandwich, June 30, 1797.

PARLIAMENT, the grand assembly of this kingdom, consisting of the king, the lords, and the commons, in whom alone exists the power of enacting and repealing laws, and levying taxes. The two houses of Parliament are assembled by the king's writ to peers personally to attend in the House of Lords; and to sheriffs to return knights and burgesses to the House of Commons. The House of Peers is comprised of two archbishops and twenty-four bishops, and of about 350 dukes, marquisses, earls, viscounts, and barons, who, if British, sit by descent or creation, or, if Scotch or Irish, by election. The House of Commons, or the house of the representatives of the people, consists of persons of landed property, who are or ought to be freely chosen by the people.

The qualification of a member for a county is L.600 per annum, and that of a member for a city or borough is L.300 per annum. The electors of county members or knights of the shire, as they are called, must be 21 years of age, and have a freehold or life interest of 40s. within the county. The electors of members for cities or boroughs, must be freemen, persons who pay poor's rates or other rates according to the nature of the charter of the place. The number of members belonging to the House of Commons is, for England and Wales 513, for Scotland 45, and for Ireland 100; in all 658. Parliament is said to be adjourned when it is put off from day to day; prorogued, when put off from one session to another; and dissolved when broke up by the order of the king, the demise of the crown, or from its continuance during its legal period.

The duration of Parliament was for three years by the constitution of the country; but the Parliament voted an extension of its own duration to seven years, in the reign of George I. The rights, liberties, and happiness of the people of Great Britain depend on the purity, virtue, and independence of members of Parliament. See ECONOMY POLITICAL, Part III. and likewise BRITAIN.

PARMA, a dutchy of Italy bounded on the east by Modena, on the south and west by Tuscany, and on the north by the Po, which divides it from Milan. Including the districts of Placentia and Guastalla, it contains 2280 square miles; and its population, according to the census taken by order of the French government, is 377,000, or about 165 to the square mile. The climate is favourable, the soil productive of corn, wine, oil, and hemp; the pastures feed numerous herds of cattle. The principal rivers of Parma, are the Taro, the Nuova, the Lenza, and the Trebbia. These rivers have their sources in the Appenines, and proceeding in a northerly direction discharge themselves into the Po. There are in the southern parts of this dutchy some considerable mines of copper, silver, iron, and salt. The Parmesan cheese is of a saffron colour, and the best is kept three or four years. It is conveyed to various parts of Europe, and is held in great estimation. The trade of the dutchy is small, and consists principally in the raw produce of the soil.

*Parma*, the capital of the above dutchy, is delightfully situated on the banks of the river Parma, which divides the city into two unequal parts, which are united by bridges. The streets of Parma are broad, regular, and clean, and meet in the centre, forming an elegant square. In general the houses are low, and of an indifferent appearance. Many of the public buildings are enriched with fine paintings, which attract universal admiration. This city is the see of a bishop, suffragan of Bologna, and the seat of the ducal administration. It has five collegiate and thirty parish churches. The cathedral is Saxon, but lined in the inside with Roman architecture; its cupola, painted by Correggio, is a masterpiece of art. The most elegant church in Parma is the Steccata, which is built in the form of a Greek cross. The cupola of the church of St John contains a beautiful painting in fresco by Correggio, who was a native of this place. The buildings of the university are spacious and handsome; they contain an anatomical theatre, an observatory, a chemical laboratory, and a museum of natural history, and the number of students is commonly about 400. The ducal palace being an extensive though unfinished range of buildings, is occupied by several public establishments, viz. the academy of fine arts, the museum of sculpture and painting, and the public library. The theatre of Parma is said to be capable of containing 10,000 spectators, but being never used, owing to the vast expense of fitting it up, it is suffered to fall to decay. In 1765 was established the royal printing-press of this city, which has produced several fine editions of the classics. Parma contains a population of about 28,500.

PARMEGGIANO. See DESIGN, Vol. II. p. 716.

PARNASSUS, a mountain of Greece in Phocis, sacred to the Muses. Though it was for the most part sterile, there were groves and small villages on it adapted to excite and inflame the poetic genius. To the Delphians it was a place of refuge in times of danger. The whole of Parnassus was famed for sanctity, but Corycium was the most celebrated among the hallowed caves and places. See GREECE.

PARNELL, THOMAS, a learned divine and ingenious poet, born in Dublin, 1679, in which capital he was also educated. In 1700 he took his degree of master of arts; three years afterwards he was ordained, and in 1705 he was presented to the archdeaconry of Clogher. He died at Chester in 1717, in the 38th year of his age, and his remains were interred in Trinity church in that city. Parnell contributed various papers to the Spectator and Guardian, and was the intimate friend of Pope and Swift. After his death, a selection of his best pieces was published by Mr Pope, in one octavo volume. His poems, by which he is exclusively known, are beautiful and pleasing, but do not entitle him to a high rank among the British poets. The general character of Parnell is not great extent of comprehension or fertility of mind. His praise must be derived from the easy sweetness of his diction. In his verses there is more happiness than pains; he is sprightly without effort, and always delights though he never ravishes; every thing is proper yet every thing seems casual. If there is some appearance of elaboration in the *Hermit*, the narrative, as it is less airy, is less pleasing. Of his other compositions it is impossible to say whether they are the productions of nature so excellent as not to want the help of art, or of art so refined as to resemble nature. Johnson's *Lives of the Poets*.

PARODY, a humorous kind of writing, which consists in applying what is written on one subject to another, or in ridiculing a work of a serious nature, by affecting strictly to observe the same rhimes, words, and cadences. It is pretty similar to what some modern writers call travesty. A distinction, however, has been accurately made between a parody and a burlesque; for the change of one word may parody a verse, or of a single letter a word. The Greeks first made use of the parody which is now chiefly employed for a poetical pleasantry. The choice of a subject, and the manner of treating it, are particularly essential in this kind of writing. A popular or well known work should be the subject; and as to the manner, it should be a perfect imitation with an intermixture of agreeable pleasantry.

PAROS, an island in the Archipelago, and one of the Cyclades. It is said to have derived its name from Paros the son of Parrhasius. It is situated between 36° 57′ and 37° 13′ of north latitude, and 25° 12′ and 25° 26′ of east longitude, and is about 40 miles in circuit. The surface of this island is hilly, but the soil is fertile and well cultivated. Wheat, barley, vines, olives, fruits, and cotton, are the principal productions, and the pastures support numerous flocks of sheep. Paros was anciently dedicated to Bacchus on account of its excellent wines, and was well known for its marble, which was of a dazzling whiteness, and used by the best carvers of antiquity. The Venus de Medicis, the Belvidere Apollo, the Antinous, and various other works, are of Parian marble. In this island were constructed and preserved, from a very remote period, the famous chronological tables distinguished by the name of the Parian or Arundelian marbles, which were purchased by the Earl of Arundel in 1627, and presented to the university of Oxford. Those excellent statuaries Phidias and Praxiteles were natives of Paros, as was also the poet Archilochus. The antiquities and elegant ruins, which are everywhere discernible, bear testimony to the ancient opulence and grandeur of this island. *Parechia*, a small town which occupies the site of the ancient Paros, is built of sculptured marble, the remains of former temples and monuments. About a league to the east of this town there are two quarries, which were so deep that the workmen were always obliged to make use of lamps, whence, as Pliny informs us, the marble was denominated lychnites. These quarries are now partly filled up with rubbish. In one of them there is an ancient bas relief engraved on the rock, representing a festival of Silenus. Paros is surrounded with excellent natural harbours; that of Naussa in particular, on the north-east coast, is one of the most capacious in Greece.

According to Thucydides, this island was originally colonized by the Phœnicians, and afterwards by the Cretans. After the battle of Salamis, it was subjected to the Athenians by Themistocles. Paros fell under the power of the Romans in the time of Pompey; and on the partition of the empire it became subject to the Greek emperors. It was given to some illustrious Venetians in 1207; but the Turks afterwards became masters of it, and it has since continued to languish under their sway.

PARR, THOMAS, a husbandman of Shropshire, who lived to the advanced age of one hundred and fifty-two years and nine months. At the age of 100 he did penance as the father of a natural child, and at one hundred and twenty he married a second wife, by whom he had a child. Parr lived in the reigns of ten kings and queens. By Lord Arundel he was brought to London in 1635, and introduced at court to Charles I. as a prodigy. He died the same year.

PARRHASIUS. See Design.

PARRICIDE, properly implies the murder or murderer of a father; but the term is likewise extended to the murder of any near relative, as a husband, wife, brother, sister, child, grandchild, uncle, &c. and even to that of great or sacred persons, though no way allied in blood, as a king, &c. Parricide was by the Roman law punished with greater severity than any other kind of homicide. The delinquent, after being scourged, was sewed up in a leathern sack, with a live dog, a cock, a viper, and an ape, and so cast into the sea. Our English laws treat this crime in no otherwise than as simple murder.

PARSON, *Persona Ecclesiae*, the proper appellation of an individual who is in full possession of all the rights of a parochial church. Such a one has during his life the freehold in himself of the parsonage-house, the glebe, the tithes, and other dues. These, however, are sometimes appropriated, that is to say, the benefice is annexed perpetually to some spiritual corporation, either sole or aggregate, being the patron of the living, whom the law esteems equally capable of providing for the service of the church as any single private clergyman. The distinction of a parson and vicar is this: the parson has generally the whole right to all the ecclesiastical dues in his parish, whereas a vicar has usually an appropriator over him entitled to the best part of the profits, to whom he is in effect perpetual curate, with a standing salary.

PARSONAGE, a rectory or parish church endowed with a glebe, house, lands, tithes, &c. for the maintenance of a minister, with cure of souls within such parish.

PARTHIA, a country of ancient Asia, bounded on the north by Hyrcania, on the south by Carmania, the desert, on the east by Osus, and on the west by Media. On every side it is surrounded by mountains, which serve as a boundary. Ptolemy divides it into the districts of Caminsene or Gamisene, Parthyene, Choroane, Atticene, and Tabiene, and makes mention of twenty-five cities, the largest of which was called Hecatompolis, from the circumstance of its having 100 gates. According to some, the magnificent city of Hecatompolis, stood on the same site with Ispahan, the capital of the present Persian empire.

Of the early history of Parthia nothing is certainly known, further than that the country was first subject to the Medes, afterwards to the Persians, and then to Alexander the Great. The Parthian empire was founded about 250 years before Christ, by Arsaces, a man of obscure birth, but considerable military talents, by whose successors, called Arsacidae, it was vastly extended, so that it possessed eighteen kingdoms between the Caspian and Arabian seas, and was even formidable to the Romans. See Persia.

PARTING, the operation of separating gold from silver by means of nitric acid and other solvents. See Metallurgy.

PARTNERSHIP, a private association of merchants to carry on a certain business at their joint expense, and share the gain or loss arising from it. There are four kinds of partnership; 1. Occasional joint trade, where two or more merchants agree to employ a certain sum in trade, and divide the gain or loss so soon as the adventure is brought to an issue; 2. Standing companies, which are generally established by written contract between the parties, where the stock, the firm, duration, division of the gain or loss, and other circumstances, are inserted; 3. Companies where the business is conducted by officers, of which there are many in this country, established chiefly for purposes that require a more ample capital than private merchants can command; and, 4. Companies incorporated by authority.—When more than six individuals are engaged in any concern, they are generally incorporated by charter or otherwise. These come under the denomination of companies. See Company, and Institution.

PARTRIDGE, a well known species of bird. See Ornithology, and Sports and Pastimes.

PARTY, in military affairs, is a small number of soldiers dispatched upon any kind of duty, such as to view the roads and ways, get intelligence, seek forage, to reconnoitre, or amuse the enemy upon a march, or to discover the enemy if near, and prevent surprise or ambuscade.

PAS, Anthony, de Marquis de Fenquieres, a celebrated general, who was so remarkably severe a disciplinarian, that it was usually said of him, "He must be the bravest man living, since he slept every night in the midst of 100,000 enemies." He died in the year 1711, having reached the age of 63. His Memoirs have been printed in 4 vols, 12mo.

PASCAL, Blaise, a Frenchman, highly eminent as a mathematical genius, born at Clermont in Auvergne, 1623, died 1672. From a very early period of life he was extremely inquisitive, and evinced a determination to think for himself on all occasions. His education was superintended by his father, who settled in Paris for the purpose. For the mathematics young Pascal shewed an extraordinary predilection, which his father was afraid might retard his progress in the languages; and he, therefore, deprived him of books on the subject, and refrained even from speaking of it in his presence. The question, what is geometry? was, however, at length asked by the youth, with irresistible importunity, and his father gratified him by replying, 'Geometry is a science which teaches the way of making exact figures, and of finding out the proportions between them;" but, at the same time, restricted him from making further enquiry on the subject. The sciences, however, occupied all his thoughts, and, at the early age of twelve years, he was found occasionally making figures on the chamber floor with charcoal, the proportions of which he ascertained by means of a series of definitions, axioms, and demonstrations. With his mathematical enquiries, he had, it is said, proceeded so far as to have found, without assistance a result not unlike the thirty-second proposition of the first book of Euclid. After this, young Pascal was permitted to prosecute his favourite study, and was moreover furnished with Euclid's Elements, of which he in a short time made himself master. He drew up an excellent treatise on conic sections in his sixteenth year, and three years afterwards he contrived an arithmetical machine, which would have done credit to a man of science. In his nineteenth year, his health was much impaired, so that he was obliged to discontinue his labours for a period. Having seen Torricelli's experiment concerning a vacuum and the weight of the air, Pascal applied himself to this subject, and made several new experiments, and thus ascertained the fact of the general pressure of the atmosphere. Having fully explained the subject in a large treatise, and refuted the objections urged against his theory, his reputation was by this means greatly enhanced, and he was frequently consulted on difficult points by the most eminent mathematicians and philosophers of his time. A problem to ascertain the curve described in the air by the nail of a coach wheel, while the machine is in motion, was some years afterwards solved by Pascal. This problem, which was proposed by Father Mercenne, had baffled the penetration of all who had before attempted it.

Owing to incessant application to study, the health of Pascal was impaired to such a degree that he was compelled to renounce for a time mental exertion of every kind. He was gradually recovering, when an accident entirely altered the manner of his life. While he was taking an airing on the Pont de Neuilly, in a carriage and four, the two foremost horses took fright opposite to a place where there was no parapet, and threw themselves violently into the river Seine. As the traces fortunately gave way, the carriage remained on the brink of the precipice; but the shock which Pascal received had the effect to threw him into a swoon, which continued for some time. Indeed it was with difficulty that he could be restored to his senses. The danger to which he had been exposed continued afterwards to impress his mind. The precipice was for weeks present to his imagination; it not only haunted his dreams, but occasioned waking visions, one of which, in particular, proved so impressive, that he wrote an account of it, and wore the paper ever after between the cloth and the lining of his coat. In consequence of this accident, which he viewed as a direct warning from heaven, a rebuke for the misuse of time, he formed the resolution of employing the remainder of his days in religious meditation, and he accordingly entered a monastic institution at Port-Royal. Notwithstanding this alteration in the manner of his life, he was not so entirely abstracted from the world as to be altogether indifferent to what was passing in it. In the disputes between the Jesuits and Jansenists, he became a partisan of the latter, and composed his far-famed *Lettres Provinciales*, which first appeared in the year 1656, under the name of Louis de Montalter. In these letters, which have been translated into all the European languages, he effectually employed his talents in ridiculing the Jesuits. Voltaire remarks of these letters, "They may be considered as a model of elegance and humour. The best comedies of Moliere have not more wit than the first part of them, and the sublimity of the latter part is equal to any thing in Bossuet."

Pascal had designed to examine the evidence of Christianity on a plan which would have required all his great learning, and all his profound intellect, to execute satisfactorily. Of this undertaking, which promised to secure the gratitude of all Christians of whatever denomination, a few fragments, collected into a volume entitled *Pensees*, are all that remain. His whole works were collected in 5 vols. 8vo, and published at the Hague, by De Tune, and at Paris by Nyon, senior, in 1779. To the Abbé Bossu the public were indebted for the collection.

Though Pascal lived only 39 years, the longer, and, what is more important, the latter part of which was spent in almost continual ill health, such, notwithstanding, was the excellence of his powers, and such the enthusiasm that impelled them, that his name is found conspicuously engraved in all the more important scientific achievements of his time, while, in the nobler parts of literature, he occupies a rank which few of his countrymen have aimed at, and still fewer attained. In a word, the character of Pascal, considered as a moral or as an intellectual man, affords a bright, though unequal specimen of human nature. As a writer, many of the more respectable of his cotemporaries pay ample testimony to his merits.

**PASCHAL**, something belonging to the Passover, or Easter. See PASSOVER.

**PASIGRAPHY**, a term derived from *πας, omnis*, and *γραφω, scribo*, and signifying the art of writing on any subject in such a manner as to be universally understood. This art, the practicability of which is deemed fanciful and absurd by some, and strenuously contended for by others, was suggested by Lord Bacon, in his Instrument of Discourse. In the works of Leibnitz, Kircher, Becher, Wilkens, and other philosophers, are given hints concerning such a system of writing, and a memoir on this subject is contained in Nicholson's Journal, Vol. II. 4to.

**PASIPHAE**, the daughter of Sol by the nymph Perseis, and afterwards married to Minos, king of Crete. She is fabled to have formed an attachment to a bull, and the celebrated Minotaur is said to have been the fruit of this unnatural passion; but others represent that the queen was betrayed in her affection by an officer of the name of Taurus, and became the mother of twins: and from this circumstance arose the name Minotaurus.

**PASQUINADE**, a term applied to all lampoons, derived from one Pasquin, a cobler at Rome, celebrated for his wit and sarcastic humour.

**PASSAU**, a handsome town in Lower Bavaria, romantically situated at the confluence of the Inn and Danube, with a bishop's see, a fort, and a cathedral considered as the finest in all Germany. The town is divided into four parts, connected by wooden bridges, and three of which only are fortified. It contains a population of 10,000 inhabitants.

**PASSIONS** are certain feelings or impressions which affect and agitate the mind, and sometimes the whole frame, according to the nature and properties of the exciting cause. This state of mind was by the Grecian philosophers stiled *pathos*, and by the Romans *perturbatio*. Although the passions have their origin in the mind, it is obvious that they do not constitute an independent principle of action, but are merely temporary excitements of those desires and affections which are ever present to the mind of man.

Passions, according to particular circumstances, produce the most beneficial or pernicious effects on the constitution. Long continued sorrow and anguish of mind never fail to generate bodily disease, and are productive of many chronical disorders. Dr Morgan maintains, "that all the grateful or pleasurable passions raise the vital tide, strengthen and quicken the pulse, diffuse the natural heat, and take off any antecedent stimulus or pressure upon the abdomen and inferior organs; and, on the contrary, the painful passions sink and depress the blood, weaken the pulse, recal and concenter the natural heat, and fix a stimulus or compression on the inferior organs. All the passions impress their characteristic sensations or modifications on the muscles of the larynx, and thus discover themselves by the different modulation and tone of the voice;" and from this he infers that the principal instruments of the passions are the nerves of the eighth conjugation, or par vagum.

Passions, in painting, signify the visible representation of the various dispositions and affections of the mind, and of the feelings excited by the sensations of pleasure and pain, with their effects upon the several features of the face. The expressions of these passions on the countenance are sometimes remarkably conspicuous. Thus, while the soul is deeply affected with sorrow, shame, compassion, or joy, the eyes swell and overflow with a moisture which descends in tears; and under the extremity of grief, the eyelids are heavy and half closed, the pupil of the eye is elevated, and the corners of the mouth are depressed, the cheeks and lips are pale, the countenance is elongated, and all the muscles are relaxed. Under the impressions of terror, fear, and horror, the eyelids are greatly expanded, the eyebrows are much elevated, and the pupil is half concealed by the under eyelids, the lips and mouth are opened so wide as to discover both the under and the upper teeth, the general colour of the face is pale and livid, and the hair becomes erect and stands on end. The feeling of contempt is expressed by the elevation of one side of the upper lip, till the teeth appear, whilst the other lip seems as if smiling in scorn; on the side where the teeth are visible, the eye is half closed, while the other is open, and the pupils are depressed. In hatred, malice, envy, and jealousy, the forehead is wrinkled, the eyebrows are knit and sunk down, the eye turned towards the object is full of fire, and the eyeball is half concealed under the eyebrows. In laughter, the parts seem all to approach towards the centre of the face, the eyes are half shut and the mouth half open, and the face assumes a glowing red colour. Le Brun has been peculiarly happy in expressing the signs of no less than twenty different passions by the pencil, although writers upon this subject have enumerated a great many more.

In epic poetry, the passions are of essential utility, as they characterize the different personages. Thus, in the character of Achilles, the quality most conspicuous is wrath, in Æneas mildness, and in Ulysses dissimulation; but the anger of Achilles is palliated by his extraordinary valour, the mildness of Æneas is aggrandised by his submission to the will of the gods, and the dissimulation of Ulysses is atoned for by his wonderful prudence.

Various ingenious speculations have been attempted by writers on this subject, to ascertain, if possible, whether the precise situation of the impetus of the passions be in the spiritual or in the material animated part of man. Some philosophers, and among them Des Cartes, consider them wholly seated in the coporeal system; but Mr Grove infers that passions "are the affections attended with peculiar and extraordinary motions of the animal spirits, and that a sensation of the soul generally precedes a change in the spirits, external objects not being able to raise a ferment in the spirits till they have first struck the mind with the idea of something noble, frightful, amiable," &c. Mallebranche considers the passions as those agitations of the soul which proceed from uncommon influence and motion in the blood and animal spirits, and Dr Cheyne views them as emotions excited in the soul by external objects, and says that they are either spiritual and become compounded and material by the interventions of the organs of life, or animal, which he defines by those effects produced by bodies or spirits immediately on the body. Dr Cogan observes, "that the affections and passions have their origin in the mind, while emotions are corporeal indications of what passes within." Passions, according to Lord Kames, may be thus distinguished from emotions. "An internal motion or agitation of the mind when it passeth away without desire, is denominated an emotion; when desire follows the motion or agitation, it is denominated a passion. External expressions of distress produce in the spectator a painful feeling, which, being sometimes so slight as to pass away without any effect, is an emotion; but if the feeling is so strong as to prompt desire of affording relief, it is a passion, and is termed pity." The celebrated Dr Reid considers resentment as a sudden and instinctive animal principle, common to the brute creation and mankind, at the same time he calls deliberate resentment a rational principle; but he entertains some doubts whether the principle of esteem as well as gratitude ought to be reckoned in the order of animal principles, or if they ought not rather to be placed in a higher order. With several writers, it has been a question whether the passions be each a distinct innate disposition, or merely modifications of those dispositions which are common to all mankind. The theories and conjectures of philosophers upon this subject are very numerous; but to pursue them farther would be of little advantage, and we shall merely refer the reader for an ample illustration of them to the works of Reid, Hartley, Locke, and Lord Kames.

The passions, when considered in a physical, medical, or moral point of view, exert a powerful influence. They are calculated to produce surprising effects not only on the human frame but on the conduct and actions of mankind, and thus serve many useful purposes in our present condition. They powerfully excite the animal spirits, and rouse the powers of the mind, to prevent whatever is hurtful, and to procure what is desirable for the body, without waiting for the deliberate and often tedious operation of reason. They make trial of our virtue, by affording us an opportunity of proving whether we will obey passion or reason when they are opposed to one another, as frequently happens in this state of probation. The passions are likewise admirably suited to our helpless condition, and, when under due regulation, are productive of the most salutary effects. Thus, fear keeps us habitually on our guard, anger protects us from insult; contrition and shame make us renounce past follies; hope and joy alleviate our sufferings, and render our duty more delightful and easy. Nevertheless the government of the passions is essentially necessary both to our present comfort and future felicity. Powerful, and often violent in their operation, they must ever be under the control and the guidance of reason, otherwise they will inconsistently magnify or diminish every object by which they are excited. Thus anger, when violent, aggravates the offence, and fear makes the danger more alarming. Cowardice and fear often swell a mole-hill into a mountain, whereas valour converts and levels a mountain into a mole-hill.

Writers on this subject have considered the passions as in a great measure *selfish*, and although they are often extended in their operation to the well-being of others, they are no doubt implanted in the soul as centinels to watch and guard us. Fear especially is considered as originating in self-love, and although it be designed to contribute to our preservation, and to secure us from danger, yet, when unrestrained by reason, it not unfrequently becomes the cause of destruction. The passions have been variously arranged by different authors, and all of them to a certain extent admit the selfish principle, which, under various modifications, assumes different names.

When the contemplation of the agreeable qualities of an individual is attended with pleasure, it is termed love; and when we ourselves are the ultimate objects of affection, it is self-love. This principle may be considered as mingling itself in some degree with almost every passion which influences the human mind. When it induces us to raise ourselves to an equality with our superiors, it acquires the name of emulation; should it be directed to the attainment of power, it is termed ambition; and should this desire be extravagant or insatiable, and be supported by the authority of law, it assumes the opprobrious appellation of tyranny. When this passion inspires with an immoderate desire of possessing what belongs to another, it degenerates into covetousness; but, should wealth be the object of pursuit, it assumes a somewhat different character, namely, that of avarice. In proportion to the value we attach to external goods, and to the desire we feel of detaining or distributing them, self-love is termed penury, frugality, or profusion; and when it leads to the pursuit of sensual pleasure it becomes luxury or sensuality. In like manner, pride, sloth, arrogance, and almost every other passion originates in this selfish feeling. But, on the other hand, the passion of love, when properly directed, excites to great and commendable objects of pursuit. When, by a noble elevation of mind, it disposes us to do good to others without the prospect of any return, it receives the name of generosity; and if accompanied with a contempt of danger, it is termed magnanimity. If country be the object of our love, it is patriotism; and if the deity be regarded with this feeling, it is devotion. Love when mixed with filial fear becomes piety; mixed with slavish fear, it is termed superstition. Devoted to particular sects, opinions, or factions in religion, it is bigotry; accompanied with uncommon violence of temper, it is zeal; and exerted in favour of any particular party or opinion, it is enthusiasm.

The language of passion is of a peculiar kind, and is not only unequal but frequently broken and interrupted, and some times figurative and violent. Some passions are silent, such as surprise and terror, which agitate the mind so violently as to deprive it of the faculty of speech.

PASSION-WEEK, that which precedes Easter, so called because then our Saviour's sufferings and death happened.

PASSIVE OBEDIENCE, a political doctrine formerly maintained by the non-jurors, but now almost exploded in this country. Imagining that monarchy is the only lawful form of government, and that hereditary monarchy is the only lawful species of that government, some have maintained the notion of a divine hereditary indefeasible right of kings, and, indeed, many still hold that it is never lawful for the people to resist their sovereign under any pretext whatever. To aggravate the illegality of the Revolution, the mistaken loyalty of the friends and adherents of the house of Stuart represented James II. as supreme over both houses of Parliament, and consequently as supreme over the legislature; but it must be obvious, that, when the king, lords, and commons shall disagree, the duty of passive obedience will justify the subject in supporting the legislature, which can only be the supreme power, when any one of these branches shall take upon itself to counteract the other two. It seems indeed self-evident, if resistance to the legislature be lawful on any occasion, that nothing but the most violent tyranny can justify it, as has been clearly demonstrated by Mr Hume; and Bishop Berkeley has, with great force of reasoning, endeavoured to prove, that resistance to the legislature can never be lawful on any occasion. See Hume's Essays and Berkeley's Measure of Submission to Civil Government. It may be observed, however, that no man is bound to do an immoral action in obedience to any human law.

PASSOVER, a religious festival among the Jews, so called because the destroying angel, who was commissioned to put to death all the first-born in the land of Egypt, passed over the houses of the Hebrews, which were marked with the blood of the paschal lamb that was killed the evening before.

The Jews celebrated this festival in memory of their deliverance from bondage and departure out of the land of Egypt. See Exodus, chap. xii.

**PASSPORT** denotes a licence granted by a prince or ruler, permitting a stranger to pass through his dominions without interruption, and also a licence for the importation or exportation of merchandize free of the duties.

**PASTES.** See GLASS MANUFACTURE and DIETETICS.

**PASTIME.** See SPORTS and PASTIMES.

**PASTORAL.** See LANGUAGE and VERSIFICATION.

**PASTURE.** See AGRICULTURE.

**PATAGONIA,** a country of South America, discovered in 1519, by a Portuguese navigator, Ferdinand Magellan. It is bounded on the north by the province of Buenos Ayres, and comprehends the extensive territory stretching from Chili and Paraguay to the utmost extremity of South America, reaching from latitude 35° to 54°. It is separated from the island of Terra del Fuego by the straits of Magellan; varies in breadth from one to four leagues, and extends in length 116 leagues from sea to sea. The air is pure and much colder than under the same parallels of latitude to the north, occasioned perhaps by the lofty mountains of the Andes, which traverse this country from north to south, and which, during a great part of the year, have their summits covered with snow. Towards the north, this territory is supplied with an inexhaustible store of fine timber, whereas, towards the south, scarcely a single tree deserving of the name is anywhere to be seen; yet the pasture is abundant, and there are great numbers of wild horses and cattle, which, having been first imported by the Spaniards, have now become astonishingly increased. The coast to the east is flat; the interior is but little known, and few good harbours have as yet been discovered. A great variety of Indian tribes inhabit Patagonia; some of them are of gigantic stature, and wear caps of skins ornamented with feathers, and are clothed with skins of guanicoes, about five feet square, sewed together. Others of the natives are savage and rude, who, notwithstanding the severity of the climate, have scarcely any covering at all, and who, like other savages, live on fish, game, and the spontaneous productions of the soil. The inhabitants are of a tawny olive complexion, and are usually painted with red earth and black streaks, or red spots on their faces, and different colours round both eyes, and some with only one circle round the left eye. By this variety they probably distinguish their tribes. The women are clothed like the men, wear rings and bracelets, but have no covering on their heads.

On the first discovery of the straits of Magellan, the Spaniards built forts and sent colonies thither, but most of the people perished, since which time no settlements have been made there by any European nation. Various accounts have been given respecting the stature of the Patagonians. Mr Clarke, who accompanied Commodore Byron in 1763, represents them as being of a copper colour, with long black hair, and some of them at least nine feet high, prodigiously stout and well proportioned, as the commodore, who was very near six feet, could but reach the top of one of their heads which he attempted on tiptoe. It is probable that, in some of these particulars, Mr Clarke must have been mistaken; for Captain Wallis, who visited Patagonia after that period, differs in his account from Mr Clarke very materially, having provided himself with measuring rods, he found that the tallest man among them measured only six feet seven inches high, and several were within an inch or two as tall; but the ordinary size was from five feet ten inches to six feet. The different reports of voyagers concerning their stature, give us reason to believe that they may vary in this particular according to their tribes, as is the case with several of the clans in the Highlands of Scotland.

The Patagonians were remarkably expert in pronouncing the English language, and would sometimes repeat a whole sentence with a greater degree of accuracy than any European foreigners. Excepting a solitary scimitar, not a single offensive weapon has been discovered among them. In hunting, the natives use a kind of sling consisting of two round stones connected together by a thong; and when they throw them, they hold one stone in their hand and swing the other about the head, and are able to hit a mark no bigger than a shilling at the distance of fifteen yards.

**PATAN,** a kingdom of Asia, in the peninsula of Malacca, between Siam and Paha. The climate is hot, but very salubrious, and the winter and summer are the only seasons, and chiefly distinguished by the wet and dry. The inhabitants are a voluptuous race, and consist of Mahometans and Gentoos. They carry on trade with the Chinese, their woods abound with wild animals, particularly elephants, and they are said to be governed by a queen who never marries.

**PATAN,** a town of Hindostan, the capital of a district of the same name in the dominions of the Great Mogul, belonging to the Mahrattas, E. Lon. 75° 50′, N. Lat. 25° 17′.

**PATARA,** or **PATERA,** in Asiatic Turkey, now uninhabited, once celebrated for a temple and oracle of Apollo. E. Lon. 29° 20′, N. Lat. 36° 15′.

**PATAY,** a small town of France, in the department of Loiret, 12 miles from Orleans, remarkable for the defeat of the English in 1429, and for the prodigies of valour performed by Joan of Arc.

**PATENT,** or LETTERS-PATENT, a term properly signifying a writ in the king's name and under the Great Seal, conferring some exclusive right or privilege; but, in common language, it is sometimes applied indifferently to the writ conveying and the right conveyed. A patent is a monopoly, and monopolies in general are subversive of that unrestrained competition which is necessary to the prosperity of a country. (See ECONOMY, POLITICAL.) In most states, ancient and modern, these injurious preferences have been adopted by despotic princes as a method of enriching their favourites, or raising a revenue. During several reigns previous to the time of Queen Elizabeth, this absurd policy had prevailed to such a degree, that it was considered by the parliament of James I. entirely incompatible with public prosperity. While it is maintained that the feeling of opposition to monopolies in general is just, one exception must be made, namely, the copy-right of a literary publication, which is assuredly the only one founded in natural right and sanctioned by justice. The 21st of James I. c. 3. is considered the declarative statute, whereby the law on this subject is decided; and the sixth section of the statute renders void the future grants of all such as do not come under the following proviso: "Provided also, and be it enacted, that any declaration before-mentioned shall not extend to any letters-patent and grants of privilege for the term of 14 years or under, hereafter to be made, of the sole working and making of any manner of new manufacture within this realm, to the true and first inventor or inventors of such manufactures, which others, at the time of making such letters-patent and grants, shall not use, so as also they may not be contrary to law nor mischievous to the state, by raising the price of commodities at home, or hurt of trade, or generally inconvenient." By the same statute are also saved the letters-patent which concern printing, saltpetre, gunpowder, great ordnance, shot, and offices.

Letters-patent must be several and distinct for England, Scotland, and Ireland; and if wished to be extended to the colonies, some small additional expense is incurred.

After an inventor has enjoyed the exclusive benefit of his invention for the period of 14 years, he must be content, in return for certain protection, to throw it open for the public advantage at the expiry of that term. It is therefore a condition of the patent, that the patentee shall put on public record a detailed description of the process by which the machine or substance is produced, in such a manner as to be intelligible to any practical mechanic or chemist. The statute of James gives the sole right of *working and making* the subject of the invention, which, by established interpretation, as expressed in all letters-patent, includes vending, so as to prevent the article, when made in a foreign country, from being sold in this.

By a writ of *scire facias* at any one's instance, in the king's name, with the consent of the attorney-general on various grounds of utility, a patent may be repealed absolutely. A writ of *scire facias* lies in three cases; first, when the king grants the same thing to two or more persons; 2dly, when the king is deceived in his grant; and, 3dly, when the grant is against law. Chief-Justice Lee states the following rules respecting the cases in which mistakes do not vitiate the grant: 1. If the king's intention is manifest, a false recital in a thing not material will not vitiate the grant; 2. It is not vitiated in cases where the king is deceived, not by the false suggestion of the party, but by his own mistake, upon the surmise and information of the party; and, 3. Although the king is mistaken in point of law or matter of fact, if that is not part of the consideration of the grant, it will not vitiate it. When a patentee brings an action against any person for infringing the patent, it is incumbent on him to shew that the invention was new, and that the specification is full and complete. It is of importance that inventors desirous of the privilege of letters-patent should be informed of the natural progress of meriting, soliciting, obtaining, and vindicating a patent.

An inventor, whenever he has determined to apply for a patent, ought to lodge a caveat at the offices of the attorney and solicitor-general, desiring notice of all patents applied for, whether for the same or the same kind of invention. Such a precaution is beneficial to an ingenious individual, who is engaged in a series of expensive and laborious experiments, but who has not sufficiently matured his invention to enable him to apply for a patent; nor is it less important to the person whose patent, although applied for, has not passed the Great Seal. It is not unimportant to an inventor actually in possession of a patent, for he may oppose all subsequent applications for patents for the same invention. The lodger of the caveat, when notice is given by the attorney or solicitor-general of a rival application, must appear personally or by proxy before one or both of these law-officers, and lay before them his invention, with evidence, if necessary, of its date, progress, &c. The same is done by the rival applicant. Each case is separately and privately considered, and the law-officers decide upon the question of priority, if the inventions are the same. If different, each will be entitled to a patent; but when neither can be decided, a joint patent is generally recommended.

For further information on this important subject, see Collier's *Essay on the Law of Patents, and History of Monopolies*; Davis's *Collection of Cases respecting Patents of Invention and the rights of Patentees*; Hand's *Law and Practice of Patents for Invention*; and Blackstone's *Commentaries.*

PATERNOSTER, a cluster of islets in the eastern seas, about 120 miles in length from north-east to south-west, and 30 in breadth, and so named by the sailors on account of the number and likeness of the rocks to the beads with which the papists tell their paternoster.

PATERCULUS, Caius Velleius a Roman historian, who lived in the reign of Tiberius, and served under him as a military tribune and lieutenant. It is supposed, that, on account of the praises that he bestowed on the conspirator Sejanus, he was cut off by the emperor. He wrote a very curious and valuable abridgement of the Roman History in two books; and considering its value, as it related many particulars no where else to be found, it is a subject of regret that a considerable portion of it is lost. One manuscript of it only has been found, and that full of defects and errors, which are owing to the transcribers. See *Annales Velleiani* of Mr Dodwell, published at Oxford, in 8vo, 1693.

PATHOLOGY. See Medicine.

PATMOS, an island of the Archipelago, situated near the coast of Asia Minor, between the island of Icaria and the promontory of Miletus. It is about 80 miles in circumference, and celebrated as the place to which St John the Evangelist was banished, and where he wrote the Apocalypse. This island is very barren and unproductive, and contains no more than 300 inhabitants. It abounds with rabbits, quails, patridges, pigeons, and snipes, but does not produce above 1000 barrels per annum of corn. In a chapel dedicated to St John, there is usually shewn to strangers a chink in the rock through which it is pretended that the Holy Ghost dictated to him the Revelation.

PATNA, the capital of the province of Bahar in Hindostan. See HINDOSTAN.

PATOMACK, a river in North America, which forms part of the boundary between Maryland and Virginia; rises in the Alleghany mountains, and flows into Chesapeak bay; navigable for ships of the greatest burden nearly 300 miles.

PATRAS, a seaport of Greece, at the entrance of the gulf of Lepanto; it is built on an eminence, and contains a population of 10,000, a great number of whom are Jews, who have several synagogues. The trade is considerable in currants, oil, wine, honey, wax, silk, and skins. E. Long. 21° 43′. N. Lat. 38° 33′.

PATRIARCHS, a name originally given to heads of the first families, who lived in the earliest ages of the world, as Abraham, Isaac, and Jacob, with his twelve sons. They exercised the offices of priest and king in their respective families; and it has been supposed by some, that the idea of hereditary power and honours was first taken from this circumstance. Among Christians the term is applied to those who had authority in the church and over other ecclesiastics, as the patriarch of Constantinople, Ephesus, and Cæsarea. Till about the close of the 5th century the authority of the patriarchs gradually increased, and all matters of importance within their patriarchate came before them as ultimate judges. They yearly assembled the clergy in council, consecrated bishops, appointed vicars or deputies for the preservation of order in the remoter provinces, and nothing of importance was done without their approbation.

PATRICIANS, among the Romans, a name given to those of noble birth, in opposition to the plebeians. But in time the consulship and other great offices became open to the plebeians as well as to them. According to some, they were the descendants of the 100 or 200 first senators chosen by Romulus, and were at first the only persons allowed to aspire to the magistracy.

PATRICK, ST. the apostle of Ireland, supposed by some to have been a native of Scotland, by others of Cornwall or of Wales, was born in the year 373. His Christian name was *Suceath*, "valiant in war," and he was taken prisoner by the Irish, among whom he remained for some time. After travelling many years on the continent, he returned, and became the instrument of converting Ireland to the Christian faith. He is supposed to have died in the year 493, but the place where he is buried is disputed.

PATRICK, SIMON, an English divine, was born at Gainsborough, in Lincolnshire, in 1626. Having entered into holy orders he became vicar of Battersea in Surry, then rector of St Paul's in London. In 1678 he was preferred to the deanery of Peterborough; and after the Revolution was raised to the see of Chichester, and next of Ely. He died in 1707, much esteemed for his piety, prudence, and zeal in the discharge of his duty. His most valuable performance is a Commentary on the Holy Scriptures, especially the historical parts, in 3 vols. folio.

PATRIMONY, an hereditary estate, or right derived from ancestors. The term has likewise been given to church lands and revenues; and it was not unusual to give their patrimonies the names of the saints whom they most esteemed, and hence the estates of the Roman church were called the patrimony of St Peter.

PATRIOTISM denotes the love of our country, and is one of the most powerful principles that can warm and animate the human heart. It impels us to vindicate the liberty, and to promote the happiness or glory of our country. It is not merely an attachment to a particular place, climate, or soil, but an affection to that moral system or society of human beings with whom we live in the same country, are descended from the same ancestors, enjoy the same privileges, and are governed by the same laws. It leads us to identify the existence and happiness of our countrymen with our own, and therefore precludes the possibility of our indulging any malignant feelings towards them. Nor, while it stimulates us to aim at the happiness or glory of our own country, does it imply any hatred to the rest of mankind. It exerts itself in the defence of our own rights, not in making aggressions upon those of others. It is not at all inconsistent with general philanthropy, but the good of our country is the peculiar object which it proposes to itself; and history will furnish the attentive reader with many examples of the privations which those animated by it have endured, and the exertions they have made to advance the object which it placed before them.

PATRIPASSIANS, a sect who appeared in the second century. They derived their name from their adversaries, who maintained that the account given by them of the union between the father and son involved the doctrine that the father suffered and died upon the cross.

PATROCLUS, one of the Grecian chiefs at the Trojan war, the intimate friend and inseparable companion of Achilles. When the latter refused, in consequence of his quarrel with Agamemnon, to assist in the war, Patroclus also declined. But being afterwards prevailed on to engage in the conflict, and having gone out in the armour of his friend, he was slain by Hector. Achilles, thereupon, laid aside his resentment, and avenged the death of his lamented friend.

PATROL, a round or march made by the guards, generally in time of war, during the night, to preserve peace in the camp.

PATRON, among the Romans, a title given by a plebeian to a certain patrician, of whom he called himself the client; also given by a slave to his master upon receiving his freedom: In the church of Rome, a saint whose name a person bears, and under whose protection he puts himself; in law, he who has the disposal of an ecclesiastical benefice.

PATRONAGE, in ecclesiastical law, the right of disposing of a church or benefice. See ADVOWSON.

PATRONYMIC, a name derived from those of parents or ancestors, as Pelides, *i. e.* Achilles, the son of Peleus, Nerine the daughter of Nereus, Fitzherbert, the son of Herbert, Peter Alexeyof, Peter the son of Alexis.

PAU, a handsome well built city in the province of Gascony in France, which formerly had a castle, a parliament, and a mint, and was celebrated as the birth-place of Henry the Fourth, and of Bernadotte the present king of Sweden, and as the former residence of the kings of Navarre. The castle is romantically situated on the brow of a rock above the Gave, a torrent which rises in the Pyrenees and empties itself into the Adour. This city contains about 9000 inhabitants.

PAVIA, the ancient *Ticinum,* a town in Italy, in the dutchy of Milan, containing a population of nearly 25,000. In this celebrated city are several churches of remarkable architecture; an university, and a bishop's see, at one time the richest in Italy. The university was founded by Charlemagne; and Spallanzani, the distinguished naturalist, was one of its professors. Pavia was built by the Gauls; it afterwards fell into the possession of the Romans, and the Lombards made it their capital in the sixth century. In 1706 it fell under the dominion of Austria, to which it is now subject, having been regained from the French in 1814. E. Long. 9° 9′ 48″. N. Lat. 45° 10′.

PAVING comprehends the formation and construction of highways, streets, and footpaths, churches, halls, courts, stables, and all sorts of ground floors, so as to make them fit and convenient for being walked on. The materials of the pavement are very various in different places and countries, as well as the manner of their arrangement. The finest streets in most of the cities of Britain are composed of flint, or rubble stone, and the pavement of churches, halls, &c. of bricks, tiles, flags, and different kinds of stone. In France, these are almost wholly composed of a kind of freestone called gret or gritt. In Venice, the streets are generally paved with brick, and the churches frequently with marble, and that of St Mark, and some others, with mosaic work. In the finest cities of Holland, the middle of the street is paved with flint or stone for carriages, and the side paths for those who walk are of brick, and are called the *burgher-master's pavement.*

The materials of the street pavement are usually laid in a bed of dry sand; those of halls, courts, and ground floors in a mortar of lime and sand, or lime and cement. Pebble-paving is perhaps the most durable, and is composed of stones from the sea-beach of various sizes, but the best are from six to nine inches in depth. Rag-paving, though much used in London, is very inferior. The rag-stone is from Kent, in the vicinity of Maidstone. Purbeck pitchens, from the island of Purbeck, are from six to ten inches square, and five deep, and are generally used in court-yards and footways. Squared, or Scotch paving, consists of a clear close stone, known in Scotland by the name of blue whynn, is inferior in durability to the granite, of a reddish-blue colour, and is now commonly used in London. The Guernsey stone is a kind of pebble, and the Yorkshire is an excellent material, and can be obtained of any size, and is not affected by the frost. The ryegate, or fire-stone, is much used for paving hearths and ovens, and is not affected by the heat, if kept dry. Newcastle are like the Yorkshire, and are about two feet square and two inches thick. The Portland paving is ornamented with black dots of marble; and the Swedland is a black slate for paving halls, dug in Leicestershire. The marble pavement is mostly inlaid in mosaic, and the flat brick pavement is laid in groute or mortar. Besides these there are various other kinds of paving, as the brick on edge laid flat, edgewise, or endwise, also with foot tiles, with clinkers, with bones of animals, and with large gravel stones.

In churches the pavement is of stones of various colours and several forms, but chiefly squares and lozenges, surprisingly diversified and arranged.

PAUL, the apostle, formerly named Saul, by profession a Pharisee, and a native of Tarsus in Cilicia, is supposed to have been born about two years before our Saviour. Having been sent early to Jerusalem to study the law under Gamaliel, he made rapid improvement in his studies; and from his great but mistaken zeal for the law, became a persecutor of the church of Christ. His history is largely detailed in the Acts of the Apostles by St Luke, who accompanied him in almost all his journies. The extraordinary conversion of this apostle furnishes one of the most convincing proofs that has ever been given of the truth and divine origin of the Christian religion. From being a furious persecutor of the followers of Christ, he all at once became a disciple himself. He was the writer of the Epistle to the Hebrews, and of several others, and he suffered martyrdom between the sixty-fourth and sixty-sixth year of our Lord, by having his head cut off at the *Salvian waters.* He was buried on the way of Ostium, and over his tomb was erected a magnificentchurch. The laborious exertions and sufferings of Paul in the cause of Christianity, form a considerable portion of the Acts of the Apostles.

PAUL, FATHER, originally Peter Sarpi, was born at Vienna in 1552. Being educated by an uncle well qualified to communicate knowledge, he made astonishing progress in his studies, and at the age of thirteen he became one of the order of the Servites (remarkable for their renunciation of the world.) He continued perseveringly in the study of literature and science, from the pursuit of which, and the love of retirement, the highest offers of preferment could not allure him. He attained the chief offices belonging to his order; his talents and worth secured him the esteem of many eminent individuals, among whom were Pope Sextus V. and Cardinal Bellarmine; but envy and jealousy prevented that promotion, to which he was so well entitled. In 1615, he defended the rights of his native city against certain encroachments of the pope; in consequence of which he experienced the most malignant abuse from his opponents; several attempts were made on his life, and at one time he was so severely wounded that he was left as dead, by five ruffians, who retired to the palace of the pope's nuncio at Venice, and afterwards escaped to Ferraro in the pope's dominions. He afterwards confined himself to his convent, and prosecuted his favourite studies intensely till his death in 1622.

His principal work is the History of the Council of Trent, in which he appears the advocate of religious freedom, and the firm opponent of ecclesiastical tyranny. This work is thus characterised by an eminent writer: "He has exposed the intrigues and artifices by which it (the Council of Trent) was conducted, with a freedom and severity which have given a deep wound to the credit of the council. He has described its deliberations, and explained its decrees, with such perspicuity and depth of thought, with such varied erudition, and such force of reason, as have justly entitled his work to be placed among the most admired historical compositions."

PAULIANISTS, Paulianistæ, a sect who derived their name from Paul of Samosata, who asserted the simple humanity of Christ; but maintained that the wisdom of the Father had descended upon him, empowering him to work miracles and instruct mankind.

PAULICIANS, a sect which appeared in the 7th century, and derived the name from Paulus, an Armenian, or from the apostle Paul, whose writings they contended contained every article of faith. They rejected the validity of the Old Testament, and St Peter's epistles; they abhorred every object of superstition. Yet some absurd opinions are imputed to them; for they denied the humanity of Christ and his real crucifixion, and also maintained the eternity of matter. They were the most considerable of any sect that appeared during the 7th century, and are supposed to have laid the foundation of the future purity of the church.

PAUSANIAS, king of Lacedæmon, and a distinguished general, who vanquished the Persian army under Mardonius at Platæa; for which the grateful Greeks handsomely rewarded him with a tenth part of the spoils. After this, elated with his good fortune, he became haughty; and being detected in designs hostile to the liberties of his country, was put to death.

PAUSANIAS, a native of Cæsarea, was a learned Greek historian and orator. He flourished in the second century, under the reign of Antoninus, and was the author of a valuable history of Greece in ten books, which is still extant, and has been translated into French by Abbe Gedoin, in 2 vols, 4to.

PAWL, among mariners, is a short piece of wood or iron, moveable about a strong central pin, which is inserted and well secured in one of the stoutest beams of the ship. It is fixed close to the capstan or windlass, to prevent these engines from returning or rolling back when there is a great stress upon them. The windlass pawl is fixed to the deck by a strong hinge, its head rests in an inclining position against the windlass, which is encircled in that part with a row of deep notches; and as the engine is turned round, the pawl-head falls successively into these, and prevents it returning. The capstan-pawl requires to be worked by hand, and moves horizontally, whereas the former is self-acting and moves vertically: As often as it is necessary to pawl the capstan, a seaman breaks off from the bars, and pushes the head of the pawl behind one of the ribs of the capstan, which has the effect to prevent its recoil.

PAWN, a pledge for security of payment of money lent. See Broker.

PEAK of Derbyshire, a chain of very high mountains in the county of Derby, remarkable for caverns and mines. In Pool's-hole there is a cave, so narrow at the entrance that access to it can only be obtained by creeping. When the entrance is passed, it opens into a wide space with a lofty roof, resembling that of an ancient cathedral, and extends above a quarter of a mile in length. Many curious figures are formed by the petrifying water of this cave, which is continually dropping in different parts of it. One pillar here is as clear as alabaster, and has obtained the name of the *Queen of Scots' Pillar*, as it is said, that Mary, when she visited this cave, only ventured thus far. Few travellers choose to examine the utmost boundary of this dreary cavern. When a pistol is fired near this pillar, the report is as loud as thunder. Near this cave is a clear stream of hot and one of cold water, so near each other that the finger and thumb of the same hand may be put into both at the same time.

Eden-hole is another chasm, formerly supposed to be unfathomable,; as a poor man was let down into it for 200 yards, and died soon after he was drawn up, being in a dreadful state of frenzy when taken out. In the Philosophical Transactions is an examination of this cavern by Captain Collins, 1682, and afterwards by Captain Sturmy in 1699. After descending four fathoms nearly perpendicular, and three more in an oblique direction between two rocks, Captain Sturmy found a spacious cavern, from whence, with a miner, he descended twenty-five fathoms more in a perpendicular direction. Here they came to a great river eight fathoms deep and twenty broad, and they continued there a sufficient length of time to prove that it did not ebb and flow with the sea. While in this place, they decerned a hollow in the rock above them, into which the miner entered and found it to be the mouth of another cavern, into which he walked about 70 paces, when he called to the captain that here he had found a rich mine; but immediately coming running out again, he cried that he had seen an evil spirit, and nothing could induce him to return. The roofs of these caverns are extremely brilliant, being encrusted with shining spar, and the floors are of whitish stone enamelled with lead ore. This was a fatal journey for Captain Sturmy, for on his return he was seized with violent headach, which ended in fever, of which he died in a few days. For a further account of these caverns, see Derbyshire.

PEAK of Teneriff. See Teneriff.

PEARCE, Dr. an English divine, was the son of a distiller, and born at High Holborn in 1690; received his education at Westminster school, where he was chosen one of the king's scholars. In 1716, appeared his edition of Cicero de Oratore, which paved the way for future eminence, for soon after he became rector of Stapleford Abbots, in Essex, and next of St Bartholomew; in 1724 he became doctor in divinity, and published an edition of Longinus de Sublimitate, with notes; in 1739, the deanery of

Westminster was given him. His talents and virtues procured him further promotions, for he was raised to the see of Bangor, and eight years afterwards to that of Rochester; and had his ambition been equal to his worth, the highest ecclesiastical dignity in the kingdom would have been conferred on him. He died in 1774. Some of his works, besides the above, are, Miracles of Jesus Vindicated; A Commentary on the four Evangelists and the Acts of the Apostles; A New Translation of Paul's 1st Epistle to the Corinthians, with paraphrase and notes.

PEARL. See Fisheries.

PEARSON, John, a learned divine, and English bishop, was born in 1613, and having entered into orders became prebendary of Netherhaven in the church of Sarum. His preferments were so rapid and numerous, that we deem it unnecessary to detail them all; the principal ones were the rectory of St Christopher's in London, archdeaconry of Surry, professorship of divinity in Cambridge, and bishopric of Chester. He died in 1686. His most valuable production is the Exposition of the Apostle's Creed.

PEAT, a substance of vegetable origin, which is one of the most important productions of alluvial ground. It is of two kinds; one is yellowish brown, of a viscid consistence when fresh, but hardens when exposed to the sun and air. In moorish lands, in Scotland, Germany, Holland, and Ireland, peat is very common. It is composed of calcarious earth and pyrites, with sometimes a portion of common salt, and by being distilled yields water, acid oil, and volatile alkali. The other species consists of the leaves, twigs, branches, and roots of trees, and of numerous plants and weeds, and is of a dark brown or blackish colour; cuts into any shape with a sharp spade, and when dried makes excellent fuel. When mixed with dung and brought into a heat, it is converted into an excellent manure, especially for dry and gravelly soils. See Agriculture.

PECK, a measure of capacity, for measuring corn, pulse, meal, potatoes, salt, coals, shell-fish. The Winchester peck contains $557\frac{1}{5}$ cubic inches; it is equal to 2 gallons=4 pottles=8 quarts=16 pints; likewise 4 pecks are a bushel, 16 pecks a coom, 32 pecks a quarter, 162 pecks a wey or load, and 320 pecks a last. When heaped up, the coal peck contains about one-third more than the corn peck when struck off; 4 pecks of coals are a bushel, 12 pecks a sack, and 144 pecks a chaldron.

PECTORAL, a vestment or sacerdotal habit worn by the Jewish high-priest, which in our version of the Old Testament is called a *breast-plate*. It was ornamented with twelve precious stones, containing the names of the twelve tribes in four rows, and was fastened by two chains and hooks of gold. The same term denotes a plate of brass worn by the soldiers in the Roman army.

PECULIAR, in the canon law, signifies a particular parish or church, having power within itself for granting probates of wills and administrations, exempt from the ordinary or bishop's court.

PEDOMETER, Podometor, Foot-measurer, or Waywiser, an instrument in the form of a watch, which, by means of a cord fastened to a man's foot, or to the wheel of a carriage, causes the machinery within to advance one notch at each step or each revolution of the carriage wheel, so as to measure the exact distance or number of paces from one place to another. It is generally used for surveying roads and long distances, where great expedition and not much accuracy is required; and the contrivance is such, that it may easily be fitted to the wheel of any carriage, so as to perform its office without any trouble. It is sometimes constructed with a bell, which, by striking, is of great use in pointing out every furlong, which might otherwise pass without being noticed.

PEDRO, Don, a name frequent in the history of the royal family of Portugal. The most distinguished was the Duke of Coinbra, one of the sons of King John, born 1394. He was a most accomplished prince, and the encourager of arts and science. Having been appointed regent during the minority of Alonso V. he discharged the duties of that office with mildness and impartiality; but his enemies instilled prejudices into the young king's mind, upon the resignation of the regent, which were too readily received. In consequence of this, he met with a different fate from what he deserved, being declared a rebel, and slain by the king's troops. See Portugal.

PEEBLES-SHIRE, or Tweeddale, a county of Scotland, extends in length 36 miles, and varies in breadth from 13 to 20. It is bounded on the north by Mid-Lothian, on the south by Dumfries-shire, on the west by Lanarkshire, and on the east by Berwick and Selkirkshire. Tweeddale is diversified by hill and dale, and the north and north-west districts are the most fruitful; produce excellent crops of wheat, oats, and barley, and are adorned with many beautiful plantations, fine seats, and populous villages. The hills in general are green to the summit; they afford the finest pasture, and feed innumerable flocks of sheep, which yield great quantities of excellent wool. Those hills that separate this county from Dumfries-shire, are the highest in the south of Scotland, rising from 2100 to 2900 feet above the level of the sea. The rivers, which adorn and fertilize the vallies, are, the Tweed, famous for its salmon-fishery, the Line, the Yarrow, and many other smaller streams, all of which abound with trout and excellent salmon; and prodigious quantities of eels are caught in the lake called the West-water Loch. The soil along the banks of the Tweed is a sandy loam; where the ground is more elevated, it is a rich loam, on a bottom of gravel; on the skirts of the hills it is a mixture of clay with loose friable earth; and towards the sources of the rivers are moss and moors. The county of Peebles cannot boast much of its mineral stores; but in some places are found lime, freestone, and slate.

This county is adorned with many beautiful seats and populous villages. The Earls of March were hereditary sheriffs of Tweeddale, which, to the ancient house of Hay, gives the title of marquis; and in the family of Douglas of Cavers is preserved the iron mace and standard of the brave Douglas, who lost his life at the battle of Otterburn, in which he defeated Henry Percy, surnamed *Hotspur*. In the church-yard of Drumelzier the famous Merlin is supposed to be buried. There was an old traditional prophecy, that when the waters of the Pansel and Tweed should meet at the grave of Merlin, the kingdoms of England and Scotland would be united, and this junction, it is said, actually took place in consequence of a great inundation when James the VI. succeeded to the crown of England. In 1811 the population of this county was 9935, and in August 1821 it was estimated at 10,046.

*Peebles,* the only royal burgh in the above county, is pleasantly situated on the banks of the river Tweed, over which there is a bridge consisting of five arches. Here are the ruins of a monastery, once the residence of several Scottish Kings, and in the neighbourhood are the remains of several Roman forts. In this monastery it is said James I. composed his poem of "*Peebles at the Play.*" Peebles, along with Lanark, Linlithgow, and Selkirk, sends one member to Parliament. It carries on a considerable trade in the manufacture of wool.

PEEK, in maritime affairs, is a term variously applied; for example, the fore, main, and mizen-peeks, are the after-extremities of the gaffs to which those sails are respectively attached. To ride with the yards a peek, is to have them tipped up contrary ways, so as to form the St Andrew's cross.

PEEL, or PEELE, a town in the Isle of Man, formerly called Holm. See MAN, ISLE OF.

PEER, a noble lord who has a seat and a vote in the House of Lords. See HERALDRY.

PEGASUS, in mythology, a winged horse, which proceeded from the blood of Medusa when Perseus cut off the gorgon's head. Apollo and the muses made use of him in travelling, and Perseus mounted him to go into Egypt to deliver Andromeda. According to the fable of the Greeks, Pegasus, in his flight from mount Helicon to heaven, threw his rider, and became a constellation; and the sacred fountain Hippocrene arose from his striking the mount with his hoof.

PEGASUS, in astronomy, one of the forty-eight old constellations, is represented under the form of a winged-horse, and is situate in the northern hemisphere between Antinous and Pisces. It contains, according to Ptolemy, 20 stars, Tycho Brahe 19, Hevelius 38, and Flamsteed 89.

PEGU, a kingdom of India beyond the Ganges, situated on the eastern side of the bay of Bengal, and bounded on the east by Siam, on the west by part of Arrakan and the bay of Bengal, on the north by the kingdoms of Arrakan and Ava, and on the south by part of Siam and the sea. This extensive country now forms one of the southern provinces of the Birman empire. Pegu enjoys a salubrious climate, and the soil is productive of corn, rice, fruit, and roots. It affords abundance of timber of various kinds, elephants teeth, saltpetre, bees-wax, sticklac, gold, lead, iron, tin, petroleum, fine rubies, and diamonds. Pork, poultry, and fish are plentiful in this country, and deer is so common, at certain seasons of the year, that one may be purchased for about fourpence. In the low flat part of the country the houses are built upon stakes, and during the continuance of floods the communication is by boats. The temples of Pegu are numerous, and are chiefly constructed of wood, varnished and gilt. In these temples are contained idols in a sitting position, cross-legged, and with ears of very large size. Of the kingdom of Pegu nothing certain was known till the begining of the 16th century, when the Portuguese discovered the East Indies. It was long independent, and in 1752 the Peguvians conquered the Birmans; but Alompra, whom the King of Pegu had continued in the capacity of chief at Monchabou, revolted not long after, and reduced Pegu to a dependent province in the year 1757. See BIRMAN EMPIRE.

*Pegu,* once the metropolis of the above kingdom, was a spacious, beautiful, and strong city before the year 1757, when it was reduced to a state of ruins. The ancient city was a quadrangle, each side measuring nearly a mile and a-half, and surrounded with stone walls and wide ditches. Of the numerous temples, which were the only edifices that escaped the fury of the conqueror Alompra, the temple Shoemadoo, or the Great Supreme, has alone been kept in a state of repair. It is a pyramidal edifice, composed of brick and mortar, without any aperture whatever,—octagonal at the base and spiral at the top, and its extreme height above the level of the country is 361 feet. An iron teo, or umbrella, 56 feet in circumference, and gilt, is placed on the top of this extraordinary pile. Three large bells are suspended near the ground on the north side of the building, to announce to the spirit Gaudma the approach of a suppliant, who places his offering on a bench near the foot of the temple. Pegu, in its present condition, occupies about one-fourth of the area of the ancient city; the north and east sides bordering on the old wall, and the others fenced round with a stockade. The houses are all constructed of mats or sheathing boards, supported on posts. The only brick buildings are such as belong to the king, or are dedicated to the divinity Gaudma. Compared with the other houses in Pegu, the waywoon or viceroy's habitation, is a respectable looking edifice, though by no means a magnificent mansion for the representative of royalty. Pegu has one main street, running east and west, crossed at right angles by two smaller streets. It is well paved with brick, which the ruins of the ancient city supply in abundance. From the apprehension, that, if the people were permitted to build houses of brick, they might erect brick fortifications dangerous to the security of the state, the use of brick or stone, in private buildings, has been prohibited by his majesty. Pegu is seated on a river of the same name, 300 miles south of Umerapoor.

PEKIN, the capital of the empire of China, the seat of government, and the residence of the emperor. The name of this city, which denotes the northern court, is given to it to distinguish it from Nanking or the southern court. For a description of Pekin, See CHINA.

PELAGIANS, a sect which derived their name from Pelagius, otherwise called Morgan, a monk of Bangor, but whether of the monastery of Bangor in Ireland, or of that of the same name and order in Wales, is not decided. This sect appeared in the Christian church about the close of the fourth or commencement of the fifth century. They maintained that Adam was by nature mortal, and whether he had sinned or not, would certainly have died; that the consequences of Adam's sin were confined to his own person; that new born infants are in the same situation with Adam before the fall; that the law qualified men for the kingdom of heaven, and was founded upon equal promises with the gospel; that the general resurrection of the dead does not follow in virtue of our Saviour's resurrection; that the grace of God is bestowed according to our merits; and that his grace is not given for the performance of every moral act, the liberty of the will and information in points of duty being sufficient. This sect was condemned by the council of Ephesus, A.D. 431; and, in a word, the Gauls, Britons, and Africans by councils, and emperors, by edicts and penal laws, soon brought it to a termination.

PELEW, or PALOS ISLANDS, a group of islands in the Pacific ocean, lying between the Caroline and the south point of the Philippine islands. They extend in the direction of S. W. to N. E. from north latitude 6° 54′ to 8° 12′, and from east longitude 34° 5′ to 36° 40′. The tall palm trees with which these islands abound, and which from a distance look like the masts of ships, it is supposed, suggested to the Spaniards from the Philippines the appellation by which these islands are denoted. The Pelew islands are about eighteen in number; and the names of the principal ones are Babelthonap, or Panlog Oroolong, Coorvoraa, Artingall, Pelelew, Emilligne, Emungs, and Pethoull. They are generally high, and of a rugged aspect, and they abound in wood, many of the trees being so large as to make canoes capable of carrying about thirty persons. Among the trees are the ebony, cabbage, carambola, manchineel, the wild bread-fruit tree, the palm, plantains, bananas, and bamboos. The most remarkable tree is one in its leaves resembling the myrtle, and in its size and manner of branching similar to the cherry tree. It has no bark, but merely an outward coat of about the thickness of a card, darker than the inside, though equally close in texture. This tree is of the colour of mahogany, and the wood is singularly hard. The chief articles of subsistence in these islands are yams, cocoa-nuts, beetle-nuts, bread-fruit, and fish, which are obtained in abundance from the neighbouring seas. None of the islands visited by Captain Wilson had any grain. The Pelewans had never made any use of the common cocks and hens till they were visited by the English; and pigeons they esteemed so great a dainty, that only persons of dignity were allowed to use them as food. They regard oranges, lemons, and the jamboo apple, as great luxuries. Their general beverage is the milk of the cocoa nut; and, on particular occasions, they use a kind of sweet drink and sherbet. They have no idea of the use of salt. From the sugar-cane, which seems to be indigenous, they prepare a species of sweetmeat. The English saw no quadrupeds, except a few rats, and several meagre cats, which had perhaps been drifted here from some wreck. The extent of the population of the Pelew islands could not be ascertained. In these islands the houses are raised upon stones about three feet from the ground, formed of timbers grooved together and fastened by wooden pins; the intermediate space and the roof being closely filled up with bamboos and palm-tree leaves platted together. The interior forms one great room with the fire-place in the centre. The domestic implements of the Pelewans are, small baskets woven from slips of the plantain tree; wooden baskets with covers, carved and inlaid with shells; and earthern vessels of a reddish brown colour, in which provisions are boiled. Their best knives are made of a piece of the large mother-of-pearl oyster. They make combs of the orange tree; fishing hooks of tortoise shell; and twine cord and fishing-nets of husks of the cocoa nut. They have the art of moulding the shell of the tortoise into little trays or dishes and spoons. Some of the females of rank wear bracelets of the same manufacture, and earings inlaid with shell. The warlike weapons of the Pelewans, resembling those of the other islands of Polynesia, are the spear, about twelve feet in length, darts, and slings, made principally of bamboo. They had no knowledge of any kind of fire-arms when visited by Captain Wilson.

The Pelewans are stout and well made, of a deep copper colour, and rather above the middle stature, with long hair, which is commonly formed into one large loose curl round the head. At an early age both sexes are tatooed, and have their teeth made black by art, and the cartilage between the nostrils bored to admit a sprig of some plant or shrub. The men go quite naked; but two little aprons made of the husks of the cocoa nut, stripped into narrow slips, and dyed yellow, are worn by the women, one before and the other behind. The men have their left ear perforated, the females both, which, according to the different ranks, are decorated with beads, earings of tortoise-shell, or a sprig of some favourite shrub. The chiefs wear a bone round one of their wrists as a mark of honour conferred by the king, and they never part with it except with life. Both men and women are expert swimmers and admirable divers, and are regular bathers everymorning; bathing they perform as a duty. In mechanical operations the Pelewans are skilful. Idleness is unknown in these islands, the time of the natives being entirely devoted either to the cultivation of the soil or to fishing.

The inhabitants of the Pelew islands are characterized by mildness, politeness, and benevolence. Their character, however, was grossly misrepresented before Mr Keat published his excellent account of the history, manners, and customs of the Pelewans. They live in the simplest state of nature, devoid of liberal knowledge, and ignorant of the arts and sciences. In their marriages they in general allow not more than two wives. They do not seem to cherish any thing like religious principles, but have some conviction that the soul survives the dissolution of the body. They have places particularly appropriated to sepulture, and unlettered monuments of stone are sometimes erected by them over the spot where the body is deposited.

Though the form of government in the Pelew islands is monarchical, there seems to be a distinct sovereign in every island. At the time that Captain Wilson was driven on these islands, the king of Coorvoraa was Abba Thulle, and the nobles of this sove-

Pelew.

reign were called *rupacks*. These rupacks "could only be regarded as chiefs or nobles; they were not all of the same degree, as was plain by a difference in the bone they wore, a mark of rank worn upon the wrist. They generally attended the king, and were always ready at his command to accompany him on any expedition with a number of canoes, properly manned and armed with darts and spears, who were to remain with him till they had his permission to return home with their dependents. In this part of their government, we may trace an outline of the feudal system; but from the few opportunities our people had of investigating points of internal government it appeared that the titles of the rupacks were personal badges of rank and distinction; nor did they apprehend they were hereditary honours unless in the reigning family, who must of necessity be of this class."

It does not appear that Europeans were acquainted with this cluster of islands before the commencement of last century. The Spanish Jesuits, from the Philippines, discovered them in 1710. Captain Wilson of the Antelope, in the service of the East India Company, was wrecked on the shores of these islands in 1783; and since the publication of that commander's voyages further accounts of these islands have been received, all confirming his interesting report. Such was the confidence reposed in Captain Wilson and his crew, by Abba Thulle the king, that he gave them the island of Oroolong, where they were enabled to build a small vessel to carry them to China; and, on their departure, he permitted his son Prince Lee Boo to accompany him to England, where he arrived in 1784, and was placed in an academy at Rotherhithe. The mental endowments of this amiable young man were rather of a superior kind, and to acquire useful knowledge he exhibited a remarkably ardent desire. He made rapid progress in his education, and was delighting himself with the prospect of carrying with him on his return home a knowledge of such things as would essentially benefit his country. This agreeable prospect, however, he was destined never to realize. He had not been many months in England when he was seized with the small-pox, of which he died in the 21st year of his age. His remains were interred in Rotherhithe church-yard, and a monument, with a suitable inscription, was by the East India Company erected to his memory. In return for the kindness shewn to Captain Wilson and his crew, the East India Company equipped two vessels at Bombay, which arrived at the Pelew islands in 1791, containing presents of different kinds; cattle, goats, pigs, geese, and ducks, with many kinds of seeds, and hardware, swords, arms, and ammunition. The intelligence of the death of Lee Boo affected Abba Thulle very much, yet he bore it with considerable fortitude and resignation; and when the presents were landed he evinced so small degree of gratitude. It is gratifying to add, that the live-stock thus sent by the East India Company have multiplied greatly, with the exception of the sheep, which have completely failed. There are now produced annually two crops of rice and other grain, and a small commercial connection has been established by the English between Pelew and China. Several Europeans now reside on these islands. See *Lettres Edisiantes et Curieuses*, Paris, 12mo. vols. xv. and xviii. *Histoire General des Voyages*, 4to. vol. xv. Keate's *Account of the Pelew Islands*. *Narrative of the Shipwreck of Captain Wilson*, &c. 12mo.

Peloponnesus || Pembrokeshire.

PELOPONNESUS, anciently called *Apia* and *Pelasgia*, a large peninsula situated between the Egean and Ionian seas, and having, on account of its angular recesses or bays, some resemblance in figure to a plantain leaf. It now bears the name of Morea. Its name denotes the isle of Pelops, and the Greeks accordingly ascribe its origin to Pelops, a renowned hero, who emigrated from Asia, and having become master of this part of Greece, called it after himself. Strabo asserts, from Homer, that one of its ancient names was Argos, with the epithet Achaicum, to distinguish it from Thessaly, called Pelasgicum. The Peloponnesus was divided into six parts. See GREECE and MOREA.

PELUSIUM, in ancient geography, a considerable city of Egypt, situated at the eastern extremity of the lake Menzale, near one of the mouths of the Nile, and, as Strabo informs us, about two miles from the sea. By Diodorus and Hirtius, it is denominated the key or inlet of Egypt, which being taken, the rest of the country lay entirely exposed to an enemy. From its ruins arose Damietta, which see. During the wars of the Romans, the Greeks, and the Arabs, Pelusium was frequently taken and pillaged. This city, however, withstood the many disasters to which it was subjected, and preserved its wealth and commerce till the time of the Crusades. It was ultimately taken by storm, and sacked by the Christian princes, after which calamity the inhabitants removed to Damietta.

PEMBROKESHIRE, one of the southern counties of Wales, is surrounded on all sides by the sea, except on the east and north-east, where it is bounded by the counties of Caermarthen and Cardigan. Its greatest length is 30 miles, and breadth 29. The name which was given to it soon after the Norman conquest, is supposed to have been derived from the British word *penfro*, denoting a cape or promontory. A great part of the county is plain, and tolerably productive, consisting of rich meadow and arable land. Except in the north-east part, which alone is mountainous, the hills are of moderate elevation; the mountainous ridge called Percelly extends about 10 miles from east to west. The climate is healthful, and instances of longevity are not uncommon. This county is very subject to rains, a circumstance which the dryness of the soil renders very advantageous. Frost is generally of short continuance; and, except on the mountains, snow never lies more than a few days. This county is very defective in its agriculture, though many improvements have of late years been introduced. The grains usually raised are wheat, barley, oats, and rye. On some farms, turnips and peas are cultivated, but with little success. The farms are from 50 to 500 acres in extent, and are almost all let from year to year, though leases, generally for a term of three lives, are granted by some proprietors. Lime is used for manure; and in some parts shelly sea sand is advantageously employed for barley crops. A superior breed of jet black cattle, with spreading horns, is produced in Pembrokeshire.

This county is divided into seven hundreds, and these again into 145 parishes. It contains one city and seven market-towns, and lies in the diocese of St David's. It sends two members to Parliament. The superficial extent of the county is reckoned at 394,400 acres. The waste lands consist of 22,220 acres, which are used chiefly as sheep walks. Considerable tracts of land here have been reclaimed by the operation of draining. In 1811, the population, according to the parliamentary returns, was 60,615, or 19 to the square mile.

The coast of Pembrokeshire is indented with a number of bays. Milford-Haven has the best natural harbour in the kingdom. (See MILFORD-HAVEN.) North of it is St Brides' bay, which is capacious and well sheltered; the other principal bays are those of Newport, Fishgard, and Aberkiker. Ramsay island, which is remarkable for being frequented by multitudes of migrating birds, is situated near St Brides. There are a number of rivers in this county, the principal of which are the Tivy, the East Cleddan, and West Cleddan. Coal, lime-stone, free-stone, and that species of marble called pudding-stone, constitute the chief mineralogical productions. There are several mineral springs, strongly tinctured with iron. Nothwithstanding all the advantages presented by its natural harbours and extent of coast, the commerce of this county is confined chiefly to some coasting trade, for the exportation of cheese, butter, coal, and stone. Owing to the want of capital, the fisheries, though productive, are not carried on to a great extent. Along the coast are various fishing-towns, one of which, Fishgard, is noted for its trade in herrings. Salmon is abundant in several of the rivers, and there is a remarkable salmon leap near Kilgerran, on the Tivy, where that fish is plentifully caught. Pembrokeshire cannot be considered either a manufacturing or a trading county; the only town within its limits having a cotton manufactory of any extent is Haverford-west, and attempts to introduce the linen business have hitherto proved abortive. A South-sea whale-fishery has been established at Milford, and is in a flourishing condition.

Among the antiquities of this county are druidical circles and cromlechs, and various stone monuments. The great Roman road to Menapia, St Davids, enters Pembrokeshire, near Llandewi-Velfry, and proceeds by Haverford-west and Roch-castle. Another Roman road led from the great road to the station called Ad-Vicesimum. Nineteen castles are mentioned as belonging to princes and great barons. They constitute the most important antiquities of the country. The cathedral and palace of St Davids are well worthy of notice.

*Pembroke*, the principal town in the above county, is situated upon a creek of Milford-haven, named Down-Pool, over which are two bridges. The strong wall which formerly surrounded it is still almost entire on the north side, where it is flanked by bastions of great strength and thickness. Of the three gates of this wall, that on the north side is the only one at present remaining. Pembroke has one long street, which is wide and well built, extends from east to west on the ridge of a hill, and terminates at the west end in a steep precipice, on which the castle stands wherein Henry VII. was born. This castle, now in a state of ruins, is, perhaps, one of the finest subjects for the pencil which Wales has to boast of. In general appearance, Pembroke bears some resemblance to the towns of Edinburgh and Stirling, in Scotland. Besides the churches, which are of great antiquity, the principal public edifices are a town-hall and a free grammar-school. Pembroke contains above 2400 inhabitants; it is governed by a mayor, two bailiffs, and common council, and, in conjunction with the neighbouring counties of Tenby and Whiston, sends one member to the British Parliament. The trade of this place is considerable.

PEN, an instrument serving to write with; made of a quill, and sometimes of silver, brass, or iron. Goose-quill pens are supposed to have been in use in this country between 400 and 500 years. Many of the quills made use of in England come from Hudson's Bay, Hamburgh, and Ireland. Dutch pens are formed of quills that have passed through hot ashes, to take off the grosser fat and moisture, and render them transparent. In some parts of the world, reeds are employed to write with to this day; and Massey, in his Treatise on the Origin of Letters, mentions that the Turks, Moors, and Eastern people, use reeds for writing. The same author remarks, that wherever the word *pen* occurs in our English translation of the Old and New Testament, we must not understand it of a pen made of a quill, but of an *iron style*, or a reed, with which the ancients wrote. The former was sharp at the one end, like a pointed needle, to write with; and at the other end blunt and broad, to scratch out what was written and not approved of. Allatius, keeper of the Vatican library, who died at Rome in 1669, had a very extraordinary pen, with which and no other he wrote for 40 years; and having lost it, he was so grieved that he could scarcely refrain from tears. Of what this pen was made is not known. Philemon Holland, a physician of Coventry, translated Pliny's Natural History into English with a single pen, as he himself asserts in the following lines:—

> With one sole pen I wrote this book,
> Made of a grey goose quill;
> A pen it was when it I took—
> A pen I leave it still.

It has been humourously remarked, that the goose, the bee, and the calf, rule the world; the one affording parchment—the other two, sealing-wax and quills to write with.

PEN, FOUNTAIN, an instrument for writing, made of brass, silver, or other metal, and contrived to hold a considerable quantity of ink, to supply the writer for a time, without requiring to be recruited. This sort of pen consists of several pieces. The middle piece carries the pen, which is screwed into the inside of a little pipe, which again is soldered to another pipe of the same size as the lid; in which is soldered a small screw, for screwing on the cover, as also for stopping a little hole at the place, and preventing the ink from passing through it. At the other end of the piece is a small pipe, on the outside of which the top cover may be screwed. In the cover goes a port-crayon that is to be screwed into the last mentioned pipe, into which the ink is to be poured by a funnel. In order to use the pen, the cover must be taken off, and the pen must be shaken a little, that the ink may run freely.

PENANCE, one of the seven sacraments of the Roman Catholics. Of this punishment, the general conditions are fastings, alms, abstinence, &c.; besides which, there are other conditions of a more particular kind, such as the repeating a prescribed number of ave-marias, paternosters, and credos, wearing a hair shirt, and giving one's self a certain number of lashes. Penance is either voluntary or imposed by authority for the faults a person has committed; in the discipline of the church, it is an ecclesiastical punishment.

PENATES, in mythology, the tutelar gods of the Trojans, which were adopted by the Romans, who called them Penates. See LARES.

PENCIL, an instrument employed by painters for applying their colours. Large pencils, called brushes, are made of boars bristles, the thicker ends of which are bound to a stick of a proper size. Fine pencils are made of camels, badgers, and squirrels hairs, and of the down of swans; these are fastened at the upper end with a piece of thread, and enclosed in the barrel of a quill. The term pencil likewise denotes an instrument made of long pieces of black-lead, or red chalk, placed in a groove cut in a slip of cedar. Genuine English pencils are made of black lead, sawn into slips. The surest way of obtaining black-lead crayons, the quality of which can be depended upon, is to take the finer pieces of black-lead, saw them into slips, and fix them for use in port-crayons. Pencils are often unequal in quality, from the circumstance of different sorts of the mineral being fraudulently joined together in one pencil. German black-lead pencils, and many of the pencils hawked about in this country, are made of a composition of black-lead and sulphur. This lead, in fine powder, stirred into melted sulphur, unites with it so uniformly, and in such quantity, in virtue, perhaps, of its abounding with sulphur, that though the compound remains sufficiently fluid to be poured into moulds, it has nearly the appearance of the coarser sorts of black lead itself. The composition of these pencils is betrayed by their melting or softening when held to a candle, or applied to a red hot iron, and yielding a bluish flame, with a smell like that of burning brimstone; for black-lead itself yields no smell or fume, and suffers no apparent alteration in that heat. Pencils made with such addition are of a very bad kind; they are hard, brittle, and do not cast or make it mark freely, either on paper or wood, rather cutting or scratching than leaving a coloured stroke.

PENCIL of RAYS, signifies a double cone of rays joined together at the base. See OPTICS.

PENDANT, a long narrow flag worn at the principal mast-head of all ships and vessels of war in his Majesty's service. A broad pendant, which is shorter as well as broader than the common pendant, is worn at the mast-head of the ship that carries a commodore or chief of a squadron.

PENDENNIS CASTLE, a fortress in an elevated situation at the mouth of Falmouth haven. This castle was built by Henry VIII. opposite to that of St Maws, and was fortified by Queen Elizabeth.

PENDULUM, any heavy body, so suspended from a fixed point as that it may vibrate backwards and forwards by the power of gravity. The name is derived from *pendeo*, to hang, or to be suspended. The theory of the pendulum is founded on that of the inclined plane, and the nature of its properties consists in the following particulars. 1. The times in which a pendulum vibrates in very small arches are all equal. 2. The velocity of the bob in the lowest point will be nearly as the length of the chord of the arch which it describes in its descent. 3. The times of the vibrations in different pendulums, are precisely as the square roots of their lengths. 4. The time of a single vibration, is to the time of the descent through half the length of the pendulum, as the circumference of a circle to its diameter. 5. The quantity of matter in the vibrating body, is as the weight and the square of the time directly, and inversely as the length of the pendulum. 6. The length of a pendulum vibrating seconds will, therefore, be found nearly 39 inches, and a pendulum of one-half second 9.8 inches.

The pendulum is, therefore, employed as an universal chronometer, or regulator of time, as it is used in clocks and time-keepers. See HOROLOGY. It may likewise be made use of to measure the distance of a ship, by ascertaining the precise number of seconds between the fire and the sound of the gun; or the distance of a cloud, by measuring the interval between the lightning and the thunder. Thus, if five seconds intervene between the lightning and the thunder, the distance of the cloud will be 5710 feet, because, in one second, sound passes through 1142 feet. By this instrument, also, may be measured the height of any room, house, or other object; for supposing a pendulum, the height of a room or other object, to vibrate once in three seconds, then as 1 is to the square of 3, namely, 9, so is 39.2 to 352.8 feet, the height required. By the same instrument, also, may be discovered the different force of gravity on various parts of the surface of the earth, and indeed the true figure of the globe itself.

The pendulum, while it is extremely useful for many purposes, is subject to one great inconvenience, its length being constantly liable to alteration from the effects both of cold and heat, by which, as is evident from the pyrometer, all metallic bodies more or less expand and contract; so that, notwithstanding all the improvements that have been made on this instrument, even to the present day, the wooden pendulum has been found to be the least subject to change and alteration from temperature, and for this reason the most accurate of any yet discovered. In the first application of pendulums to clocks, they were made extremely short; and as the arches of the circle were large, the times of the vibrations could not be equal; but to remedy this defect they contrived to make the pendulum vibrate in the arch of a cycloid. See MECHANICS and HOROLOGY. In the above remarks, it has been supposed that the power of gravity has been constantly the same; but if this should vary, the length of the pendulums must also vary in the same proportion, that they may vibrate in equal times.

In consequence of the variation of the rate of a clock from summer to winter, occasioned by the state of the weather, several contrivances have been proposed, by constructing pendulums of different metals, so arranged, that their effects may counterbalance each other, so as to preserve the length of the pendulum uniformly the same.

*The Mercurial Pendulum*, by Mr George Graham, was the first invention of this kind. It consisted of a hollow tube of glass, into which a certain quantity of quicksilver was introduced; and on farther trial, instead of a glass tube, he used a brass one varnished inside to prevent it from being injured by the mercury. By experiment, it has been found that if a tube of glass or metal uniform throughout, and 58.8 inches long, be filled with mercury and applied to a clock, it will vibrate for 39.2 = ⅔ of 58.8, and a pendulum of such construction will be liable to two-fold expansion and contraction, one of the mercury, and the other of the metal, in opposite directions, so as to correct each other. By the heat the metal will expand in length so as to make the pendulum vibrate slower; and the mercury will likewise expand, and by this means extend the length of the column upwards, so as to elevate the centre of oscillation; hence its distance from the point of suspension will be diminished, and the vibrations will be accelerated. By the judicious adjustment of the tube and the mercury, the time of the clock may, for a long time, continue uniform without any perceptible loss or gain. In 1721 Mr Graham constructed a clock of this kind, and, after comparing it with one of the most accurate common clocks for three years together, it was found that the errors of the former were only one-eighth part of the latter. The same gentleman also constructed a pendulum composed of three bars, one of steel, and between two of brass, the steel being designed to raise the pendulum when expanded by the heat, and to let it down when contracted by the cold; but this invention did not succeed, as the clock, in its motion, was found to be liable to sudden starts and irregularities.

*Elliot's pendulum.*—To remedy the jerks and starts to which a clock of this kind may be liable, the ingenious Mr Elliot invented a pendulum consisting of brass and iron, which is described in the Transactions of the Royal society; but this was likewise found liable to objections. In addition to the irregularities occasioned by heat and cold, pendulum clocks are likewise subject to other inconveniences from foulness and from friction. To obviate these, Mr Harrison invented several methods, by which he rendered his time-pieces so perfect that they never needed to be cleaned, and were almost entirely free from friction; and for this ingenuity he was rewarded by the English government with L 10,000.

*The gridiron pendulum* is a contrivance intended to remedy the same inconvenience. It is formed of any convenient odd number of rods, such as three, five, or seven, and is so constructed that the effect of the one set of these rods counteracts that of the other, and are adjusted so as to make the centres of suspension and oscillation always equidistant. The effect of the steel rod is to increase the length of the pendulum in hot weather, but to diminish it in cold, whereas the brass rods do precisely the reverse. See a description of this pendulum in the article HOROLOGY, p. 297, and a representation of it in Plate 103, Fig. 6.

*M. Thiout's improvement* is another excellent contrivance, which has been for many years adopted in this country as well as in France. It consists of a bar of the same metal, and of exactly the same dimensions as the pendulum, fixed to the back part of the clock-case, and to a horizontal projecting bar. At the top of this the upper part of the pendulum is attached by means of two small silken cords or flexible chains, which pass between two brass plates immediately below, and whose under edges always limit the extent of the pendulum above. On the back of the case is fixed a pedestal, on which the plates are supported; and the bar itself, resting upon an immoveable base at the under end, is inserted into a groove which keeps it invariably in the same position. By this construction, the expansion and contraction of this bar and of the pendulum must always be contrary and equal, and therefore the length of the pendulum below the plates of brass will uniformly be the same. In 1788 Mr Crosthwaite of Dublin made some improvements on this pendulum, so that it may be considered superior to all compensation pendulums composed of different materials or metals, how exactly soever they may be adjusted.

*Reid's compensation pendulum* is likewise entitled to notice, from its remarkable simplicity. It consists of a steel rod extending the whole length, with a bob supported upon a compensating cylinder of zinc surrounding the rod, and resting upon a nut of a screw tapped upon the end of the steel rod to bring it to exact time. While the steel rod expands downwards by heat, the zinc to an equal extent expands upwards, so that the distance of the bob from the point of supension constantly remains the same, whatever may be the expansion or contraction. If, instead of steel for the rod, platina were made use of, and steel instead of zinc, a pendulum might be constructed much more compact and equally correct, though more expensive. Several other compensation pendulums have been constructed by other ingenious individuals, such as Ward, Ritchie, Daughty, Leslie, and several more.

*Ward's compound rod* is composed of a rod of zinc interposed between two flat rods of iron or steel, and is upon this principle, that if any degree of heat or cold be applied to it, and if the one of zinc expands and contracts as much as the other two together, the distance from the point of suspension to the centre of oscillation will continue precisely the same. The inventor states the advantages of this pendulum as consisting in its *simplicity*, in its being very easily constructed, in its compensation being easily increased or diminished without stopping the clock more than a minute, and in its being less expensive than any compensation pendulum hitherto made known.

*Ritchie's compensation pendulum* operates upon the same principle as the compensation balance made use of in chronometers, that is, in the flexure of a bar constructed of brass and steel, or of two metals of different powers of expansion under different degrees of heat. His improvements consist in the application of the two expansion bars, and the springs that remove the weight of the ball of the pendulum from the expansion bars, and in having only one pendulum rod and the compensation near the ball. Many opinions were delivered by individuals in the trade in favour of this pendulum; and Mr Ramsay of Islington thus describes its superior properties:

"The gridiron pendulum has much friction, is difficult to adjust, and, from the great weight of the rods, the centre of the oscillation is much above the centre of gravity. Ellicott's pendulum, in its improved state, is objectionable on account of its friction; Ward's pendulum has likewise friction; Read's pendulum has friction, and depends upon a doubtful metal, viz. zinc. Doughty's pendulum has the sole weight of the ball and two pendulum rods resting on the extreme ends of a long compound bar placed at the upper end of the pendulum, which cannot be adjusted without altering the length of the pendulum, and, from the weight of the rods and bar, the centre of the oscillation is considerably above the centre of gravity. Grimaldé applied a single compound bar to the lower end of a pendulum, but it is now laid aside. Ritchie's pendulum has only one steel rod, with two short compound bars of brass and steel, placed near the ball at right angles to the pendulum rod; the bars being parallel, admit of perfect adjustments without altering the rate of the clock. A simple contrivance is introduced between the compound bars, which takes off the weight of the ball, and leaves them at liberty to contract or expand free of every encumbrance.

"The compound bars may be reduced to the size of the pendulum rod, and will be equally affected by heat and cold. It is free from friction. It has some advantages over the mercurial pendulum, by being portable, and not liable to be deranged. It may be applied to the smallest table clock, or the largest turret. It is likely to be of great public utility, and can be afforded for less than half the expense of the most approved pendulums."

*Leslie's short pendulum,* to vibrate seconds, consists of two weights of any form or size connected by a horizontal bar, and which is suspended by two springs, the upper ends of which pass through another bar, in the same manner as other pendulums of common clocks are suspended, and which can be applied to a clock of any size, and with any escapement. The motion of this pendulum is horizontal. Its advantages over other pendulums that vibrate twice or more in a second are, that it has but one-half as much friction in the escapement, and but one-half the resistance from the air,—that the same clock will keep in motion one of four times the weight,—that it is applicable to clocks or time-pieces of any size or height from three inches and upwards, and will both beat and shew the seconds as distinctly in a small portable clock as in one of the largest size.

*The fir pendulum,* especially that formed of the wood called sapadillo, has been much esteemed on account of the expansion and contraction being so very little affected by a change of temperature. The valuable properties of such pendulums, however, are rather impaired than improved by previous varnishing or gilding, and nothing more is required than rubbing them with a little wax and a cloth or sponge.

*The angular pendulum* is constructed of two legs, like a sector; and being intended to diminish the length of the common pendulum, while, at the same time it keeps the time of vibration, it is suspended by the angular point. The duration of the time of its vibration increases with the angle, and depends on the length of the legs and on the angle contained between them conjointly, so that it may be so constructed as to oscillate in any given time; and hence, if it vibrates half seconds when its legs are closed, it will vibrate whole seconds when they are extended, so as to contain an angle equal to 151° 2½′.

*The circular or conical pendulum* was the invention of M. Huygens, and derived its name from the figure which the string or ball of the pendulum describes. Dr Hooke likewise claims the merit of this discovery. This pendulum must be so constructed that its ball may describe its revolutions in a paraboloid surface; and hence the rod of the pendulum must necessarily be flexible, and must be suspended in such a way as to form the evolute of the given parabola. In clocks which move by a pendulum of this kind, the pendulum is entirely silent, and the second hand advances with a uniform and regular process, without being liable to jerks and starts.

*Elliptic and rotulary pendulums* have likewise been invented; but they have never reached any degree of eminence, and have hitherto only existed in theory. Mr Kater attempted to remedy the errors and inconveniences of the gridiron and mercurial pendulums, by constructing the rod of a pendulum of wood, and employed zinc for a compensation. A general description of this pendulum by the inventor himself will be found in *Nichol. Jour.* Vol. XX. See a description of an improved compensation pendulum, by Mr Bryson of Edinburgh, under HOROLOGY, p. 301, and a representation of it in Plate 104, Fig. 5. It seems to be an improvement upon the compensation pendulum of Mr Ritchie. See also pendulum under MECHANICS.

Not only has the pendulum been used for the measurement of time, but it has also been proposed as the only proper standard from which all measures of length, superficies, and solidity may be derived; and a bill was brought into Parliament in 1823, and passed in 1824, to reduce them to uniformity upon this principle throughout Britain.

PENDULUM ROYAL, or EIGHT-DAY CLOCK, a clock whose pendulum vibrates seconds, and which goes eight days without winding up; shewing the hour, minute, and second.

PENELOPE, in Grecian history, the daughter of Icarus, and wife of Ulysses, by whom she had Telemachus. To be freed of the importunity of her lovers, who solicited her during her husband's absence at the siege of Troy, she promised to marry him who was able to shoot with the bow of Ulysses; but not one of them was capable for the task. They notwithstanding still urged their suit, and she promised to make choice of one after she had finished a piece of tapestry she was weaving. She, however, undid in the night what had been wove through the day, and amused them in this manner till her husband's return.

The artifice of Penelope to deliver herself from the importunity of her lovers, has given rise to the proverb of *Penelope's web*, which is applied to whatever labour can never be ended.

PENINSULA, a portion of land almost surrounded with water, but joined by a narrow neck to the main.

PENITENTIAL, an ecclesiastical book among the Papists, wherein is prescribed all that relates to the imposition of penance, and the reconciliation of penitents. There are several Penitentials, as the Roman Penitential, that of the venerable Bede, that of Pope Gregory III., and others.

PENITENTIARY, in the ancient church, were certain presbyters or priests appointed in every church, for the purpose of receiving the private confessions of the people, and acquainting them what sins should be expiated by public penance, and appointing private penance for crimes of such a nature as could not properly be censured in public. The same term applies to an office at the court of Rome, in which the secret bulls, graces, or dispensations, relating to cases of conscience, confessions, and the like, are examined and delivered out.

PENITENTS are certain religious fraternities, known by the peculiar colour and shapes of their habits, as the White penitents, the Black penitents, and the penitents or converts of the name of Jesus. These are secular societies, who have their rules, statutes, and churches, and are empowered to make public processions under their distinguishing crosses or banners. Of the White penitents, whose habit is a kind of white sackcloth, and who have on the shoulder a circle, in the middle of which is a red and white cross, there are a few distinct sorts at Rome, the oldest of which was instituted in 1264. These religious give portions annually to a particular number of young females, in order to their being wedded. Of the Black Penitents, the most considerable are the Brethren of Mercy, instituted by some Florentines in 1488, to assist criminals during their confinement and at the time of their death; their habit is black sackcloth; and some, whose bussiness it is to bury such persons as are found dead in the streets, wear a death's head on one side of their habit. There are likewise blue, grey, green, red, and violet penitents.

PENN, William, a distinguished character among the people called Quakers, and founder of Pennsylvania, was born in London in the year 1644. From his father, Admiral Sir William Penn, he received a liberal education; and in 1660, he was entered a gentleman commoner of Christ Church, Oxford. The preaching of a Quaker of the name of Loe influenced his mind to such a degree, that he withdrew with some other students from the church of England, and held private meetings for devotional exercises; in consequence of which, he was not only fined for nonconformity, but even expelled the college. He thus incurred the displeasure of his father, who had indulged prospects of his advancement at court, where he himself was in high favour. His father, however, sent him to France in company with some persons of quality, where he remained some time, and acquired a knowledge of the French language, together with other polite accomplishments. He returned to England in 1666, and suffered much on account of his sentiments, to which, however, he adhered with stedfastness. During his confinement in the Tower of London, he wrote his well-known book, No Cross no Crown. He lived much of his time in Sussex, and accompanied George Fox and Robert Barclay on a mission to Holland and Germany. In 1681, Charles II. in consideration of the services of Sir William Penn his father, and sundry debts due to him from the crown at the time of his decease, granted Mr Penn and his heirs, by letters patent, the province lying on the west side of the river Delaware, in North America, and made them absolute proprietors and governors of that country; the name too was changed, in honour of Penn, from the New Netherlands to Pennsylvania, it having been a sylva, or a country overgrown with woods. Upon this he published "A Brief Account of the Province of Pennsylvania;" proposing an easy purchase of lands, and good terms of settlement, to such as should feel disposed to remove thither. He gave just and wise laws to the new settlement; and to his honour be it remarked, that, in his legislative code, the sacred rights of conscience were left free and unfettered. He remained in Pennsylvania about two years, and returned to England in 1684. Upon the accession of James to the throne, Penn was taken into great favour with his majesty, which exposed him to the imputation of being a Papist; but from this he fully vindicated himself. In 1699, he, with his wife and family, embarked for Pennsylvania, whence he returned in 1701, for the purpose of vindicating his proprietary right, which, during his absence, had been attacked. Penn was in great favour with Queen Anne, and was frequently at court. He had the misfortune to be involved in a law-suit in 1707 with the executors of an individual who had been his steward; and as the Court of Chancery could not relieve him, he was obliged to live within the rules of the Fleet for several months, till the matter in dispute was decided. The ministry now endeavoured to avail themselves of his embarrassment, by making a purchase of the province of Pennsylvania. Penn demanded the sum of L.20,000 for it, and at length proposed accepting L.12,000, when he was prevented by indisposition from completing the sale. As the estate was not sold, the proprietaries, after the revolution in America, received the sum of L.130,000 from the legislature of Pennsylvania, in lieu of their quit rents, besides retaining many valuable tracts of land. From the British Parliament likewise they received L.4000 per annum, as a remuneration of their losses, and of the services of their ancestor.

After his return to Europe, Penn generally lived not far from London. Feeling his health decline, he, in 1710, took an elegant seat at Rushcombe, near

Twyford, Bucks. In 1718 he died of a gradual decay, occasioned by apoplectic fits; and his remains were interred in the Quakers' burial-ground at Jordans, near Beaconsfield. Penn was the great bulwark of Quakerism, in behalf of which he wrote a variety of pieces, the most esteemed of which are the following:—Primitive Christianity Revived; Persuasive to Moderation; Rise and Progress of the People called Quakers; Good Advice to the Church of England; Roman Catholic and Protestant Dissenters; The Sandy Foundation Shaken; No Cross no Crown; The Great Case of Liberty of Conscience Debated; The Christian Quaker, and his Testimony Stated and Vindicated; A Discourse of the General Rule of Faith and Practice, and Judge of Controversy; An Address to Protestants. The whole works of William Penn are comprised in 6 vols. 8vo. and are greatly esteemed among the society to which he belonged.

**PENNANT, Thomas**, an eminent naturalist and antiquary, was born, in 1726, in Flintshire, North Wales, where his family had resided for several hundred years. Having acquired the rudiments of education at Wrexham, he was sent to Fulham, and from thence to the university of Oxford, where he made considerable progress in classical knowledge, and, at the same time, applied himself to the study of jurisprudence, though he never designed to follow the law as a profession. The perusal of Willoughby's Ornithology, it is said, first excited in him a taste for natural history, for his knowledge of which he afterwards became so conspicuous. After travelling over England, he went abroad, and was introduced to Buffon, Linnæus, and other distinguished men. In 1750 he published the British Zoology, a work of no small merit. His Tour in Scotland, which passed through several editions, was first published in 1771. This work was succeeded by a variety of ingenious performances, among which are, a Tour in Wales, a Journey from Chester to London, and an Account of London. He likewise published Literary Memoirs; and at the time of his death, in 1798, he was engaged in a description of India, of which one volume was printed. Mr Pennant was a man of a strong and vigorous constitution; his countenance was open and expressive, his disposition cheerful and active, and both in writing and conversation he was remarkable for veracity. In the relations of domestic life, he was most exemplary. To the political and religious liberties of his country, he was warmly attached; and he observes, "Neither king nor people shall have the sole keeping of my political conscience. Free was I born, free have I lived, and free, I trust, will die." See his Life, written by himself.

**PENNI, Luca**, a celebrated painter and engraver, who studied under Raphael and Pierino del Vago. See Design.

**PENNSYLVANIA**, one of the United States in North America, which belongs to what is termed the Middle division. It lies between 39° 42′ and 43° north latitude, and between 74° 49′ and 80° 9′ west longitude. On the north it is bounded by the state of New York, and the country of the Iroquois, or Five Nations; on the east by the river Delaware, which separates it from New York and New Jersey, and by the Atlantic ocean; on the south and west by Virginia, Maryland, and the Ohio. Its length, from east to west is above 270 miles; and its breadth, which varies considerably, is nearly 160 where greatest.

*Aspect.*—Towards the coast, like the adjacent territories, Pennsylvania is flat, but rises gradually to the Apalachian mountains on the west. Divided by these, the state exhibits, towards the east, a beautiful variety of hill and dale, terminating near the ocean in one uniform level; while the tract of country which stretches to the west is an immense plain, deeply cut in every direction by hollows and channels, seemingly produced by excessive rains.

*Mountains and Rivers.*—The Alleghany range of mountains, which intersects the United States, is here divided into numerous ridges, which have received different appellations. These are the Blue mountains, Peter's, Tuscarora, Nescopek, Great Warriors, Evitts, Bald Eagle, and Ragged mountains; Shareman's and Sideling's hills; the Laurel and the Chesnut ridges, &c. The chief rivers, are the Delaware, Susquehanna, and Schuylkill. These all rise to the north in the country of the Iroquois, and run nearly parallel towards the south. The Delaware falls into the Atlantic, between the promontaries or capes May and Henlopen, forming, at its mouth, the large bay, called Delaware bay. It is navigable above 200 miles. The Susquehanna, running south, nearly through the middle of the state, falls into Chesapeake bay, and is also navigable a great way for large ships. The Schuylkill, after a long course to the south, turns eastward, and falls into the Delaware at the city of Philadelphia. It is navigable for boats above 100 miles.

*Climate.*—The changes in the state of the atmosphere are said to be great and frequent. The range of Fahrenheit's thermometer is from 20 below to 105 above zero. It has been known to vary 50 degrees in 26 hours. These changes from heat to cold are attended with alterations from moisture to dryness no less remarkable. Storms are frequent, and occasionally so violent as to tear up trees and unroof houses. The standard heat at Philadelphia is 52°, which is the temperature of spring water in the deepest wells. At the same time, few months pass in which frost is not, in some degree or other, observable. North-west winds are dry and cold—the north-east bring moisture. The climate to the west of the Alleghany mountains is less variable than to the east. Dr Rush has said that the Middle States, in general, have the temperature of Britain in Spring, the heat of Africa in Summer, with the sky of Egypt in Autumn, and the cold of Norway in winter; while he adds, that they are apt to be visited, to a certain degree, with the tempests of the West Indies, at all seasons. Ministers, in the hotter months, sometimes preach under the shade of a tree, with only a robe of muslin for a gown. The weather in April, May, September, and October, is usually delightful. Philadelphia, and most of the counties of Pennsylvania, have lately become more unhealthy than they formerly were; but the cause has not yet been fully ascertained. Malignant fevers frequently attack the inhabitants, and spread with dreadful devastation;

the ravages of the yellow fever, in particular, must be known to every one.

*Soil and Produce.*—As might be expected in such an extensive district, there is great diversity of soil. It contains, however, more land of the first quality, in proportion to its size, than any other of the American states. Some of the more elevated regions are extremely sterile, but a rich black mould is common in the vallies. Lancaster county has been esteemed the most fertile. The natural produce of the state does not differ materially from that of New York and New Jersey. The staple commodity is wheat, which is said to be excellent. Rye, Indian corn, oats, hemp, and flax, are also extensively cultivated. Some rice is grown, but in no great quantities; and some tobacco, which is not equal in quality to that of Virginia. The maples, from which sugar is obtained, abound on the richer soils in many parts of the United States, but those of Pennsylvania are allowed to be the most productive. These trees attain their full growth in about 20 years; and then the sap, of which the sugar is made, is procured, sometimes simply by incision with an axe, more frequently, however, by perforation with an augur. In the last case, a spout, or drain, is fixed in the hole, from which the sap flows into a receiver. It may be converted into sugar by evaporation, or by freezing, which is sometimes practised when the trees are wounded in February, but still more expeditiously by the usual process of boiling. One tree may furnish from 20 to 30 gallons of sap, which afford from five to six pounds of sugar. This tapping, so far from injuring the tree, is said to improve its vigour.

*Natural History.*—In the botanical department we meet with nothing peculiar, or particularly worthy of notice. The flowers, trees, shrubs, and culinary vegetables, are the same with those of the other middle states. In the western counties, the chesnut, black walnut, the butter-nut, the locust, and various kinds of magnolia, abound. Everywhere the woods chiefly consist of oak. The soil and climate are supposed to be well adapted for the cultivation of vines, but hitherto the experiment has not been made to any considerable extent. Among birds, the more singular are the Pennsylvania pheasant, the Carolina pigeon, the Maryland partridge, the wild turkey, and the ruffed grous. Deer, rabbits, and hares, are numerous, as are also squirrels of different kinds, the musk rat, the racoon, and oppossum. Nor has the brown bear and wolf been yet exterminated. Sulphur springs occur in Cumberland and York. In the northern department is a creek called Oil creek, from the surface of which considerable quantities of a bituminous substance resembling Barbadoes tar are collected. In the vicinity of Reading a large stream sinks into the ground, and is supposed to reascend at some distance into a pond, from which a full mill-stream constantly issues, without receiving any visible supply. Copper, lead, plumbago, and iron ore, or sand, rank among the minerals. Slate is abundant; and some quarries of marble have been opened. Coal is found near Wyoming, in the Alleghany and some other districts. At Luzerne, a species of blind coal, or iron, is said to be superior to ivory-black. There are in the country three remarkable caverns; the only one of them which has been described is on the banks of the Swetara, in the county of Lancaster. It is spacious, and encrusted with petrefactions of various shapes. Even the streams which are most remote from the ocean abound in marine petrefactions.

*Agriculture and Commerce.*—Most of the land has been cleared of the forests, though all that is cleared is not yet brought into cultivation. Between the river Alleghany and the lake Erie, the government had, not long ago, more than 100,000 acres for sale, partly cleared. Several marshes were wont to be mentioned, of which the chief were the Great swamp and Buffaloe swamp. These were long deemed unfit for any useful purpose, but are now converted into rich farm land, or covered with beech and sugar-maple. Two-thirds of the inhabitants are supposed to be employed in agriculture, which has rapidly improved during the last twenty-five years, by the introduction of gypsum as a manure, the cultivation of clover, and a skilful attention to rotation of crops. Some of the farmers in the back parts have about a hundred hinds. The Merino breed of sheep has been introduced, and succeeds very well, yielding of washed wool about four pounds per fleece. The wheat is usually made into flour, and then exported. Of this article there seems to be no import, nor does what is exported return in a different form; it is always consumed by those who purchase it, and the demand never fails. The other chief articles of export are Indian corn, iron, maple-sugar, molasses, rum, mahogany, walnut-logs, lignumvitæ, hats, flax-seed, salt, lard, butter, bees-wax, barrelled beef, or pork, and hams. Iron founderies are numerous, as are also cotton-mills. In several manufactories, if that term may be applied with propriety, the machinery is driven by steam, and three companies have been established for making steam-engines and steam-boats. The internal traffic of the state is exceedingly favoured, not only by the great rivers already mentioned, which traverse it from north to south, but by the many inferior streams which intersect the country. The commerce on the west is carried on by the Ohio with the Spanish, by the lakes with the British, and by both with the Indian tribes.

*Divisions.*—At first the state consisted of seven counties, four of which were styled the upper, and three the lower. They were afterwards increased to 21, and are now said to be about 50. Among them we find many whose names have been borrowed from England, such as, Bucks, Lancaster, Berks, Northampton, Bedford, Huntington, York, Cumberland, Westmoreland, Northumberland; these, with Philadelphia, Delaware, Dauphin, Fayette, Luzerne, Washington, and Alleghany, are the chief. The city of Philadelphia, once the capital of all the United States, is still the capital of Pennsylvania. The other towns of considerable size or importance are, Lancaster or Conestogo creek, Carlisle in Cumberland, Edinburgh in Cambria, Pittsburgh in the Alleghany district, Columbia, Sunbury, Bethlehem, Nazareth, Harrisburgh, and Washington. The population may now be reckoned at nearly 900,000, inhabiting 46,000 square miles.

*Literature, &c.*—The inhabitants are, in general, temperate and industrious. Two-thirds being originally emigrants from Britain, and the rest from Germany, British manners predominate; but the stern character of the Germans, and the plainness of the Quakers, whose influence was at first very extensive, have given a cast to the body of the people, which strangers are apt to deem somewhat gloomy and morose. The combination of perseverance and active industry, however, produced by the mixture of these nations, tended greatly to advance the interests of the rising community. For a long time, neither literature nor philosophy could be much attended to, nor is a high respect for these to this day a general characteristic of the Pennsylvanians. Some change was produced when this state became the seat of the federal government, the happy influence of which is still apparent. Learning is more valued, and cultivated with greater ardour, on the whole, than in other parts of the United States. Besides academies in different counties, there is a university at Philadelphia; a college at Carlisle, with a principal, three professors, a library of 3000 volumes, and a philosophical apparatus; and another college at Lancaster, called Franklin college, intended solely for Germans. At Philadelphia, and other principal towns of the state, institutions of a more general kind, for promoting the interests of science and humanity, have been formed. Of these, the chief are the American Philosophical society, instituted in 1769, which lately consisted of about 500 members, among whom it ranked, by honorary election, some of the most respectable names in Europe,—the college of Physicians, for the advancement of medical, anatomical, and chemical knowledge, instituted in 1787,—a society for Political inquiries, also founded in 1787,—a society for promoting the Abolition of Slavery,—another, among the United Brethren, for the propagation of the Gospel,—an Agricultural society,—and a society for the encouragement of Manufactures and the Useful Arts. There is no established religion. Any man, whatever be his creed, and even though he should have none, may aspire at the highest national honours. The Quakers form the chief part of the inhabitants; but besides these, and not few, who make no profession whatever, there are Presbyterians, Episcopalians, the Dutch-reformed church, Moravians, Catholics, Baptists, and some sects of a more obscure and rather fanatical character,—Mennonists, Tunkers, and Zwingfelters.

*Government.*—The constitution nearly resembles that of Great Britain. The legislative power is vested in a general assembly, which consists of a senate and house of representatives. All bills of revenue must originate in the latter, but the former may propose amendments; and when a bill has passed both houses, it is presented to the governor, who, if he approves it, sanctions it with his signature. Should he return it, however, it may still be converted into a law, independently of his consent, if, on reconsideration, it be approved of by two-thirds of both houses. The representatives are chosen annually, the senators once in four years. The number of representatives is apportioned to the several counties, according to a census of taxable inhabitants, made at the close of every seven years; it can never be less than sixty, nor greater than an hundred. All the members of the assembly receive a compensation for their services, and have privileges similar to those of our members of Parliament; but none of them can hold any civil office. The supreme executive power belongs to the governor, who is also elective, and holds his office for three years. For the exercise of the judicial power there are various civil courts, similar to those of our own country; and in these also the principles of English jurisprudence have been adopted to a considerable extent. The criminal court has been celebrated for the humane and judicious measures by which it endeavours to reclaim such prisoners as may again return to society.

*History.*—New York, the Jerseys, and Pennsylvania, were discovered in the reign of Henry VII. by Sebastian Cabot, who claimed them for the crown of England. The first colonies, however, were planted on these shores by Sir Walter Raleigh, in the reign of Elizabeth, who, in honour of his queen, gave all the eastern coast the name of *Virginia.* Both the Dutch and the Swedes afterwards obtained settlements in these territories, and the former, in consequence of some pecuniary transactions with Mr Hudson, who came out to Virginia in the reign of James I. laid claim to the whole. This claim having never been recognised by the crown, Charles II., during the first Dutch war in 1664, gave the lands to his brother James duke of York, who immediately sent over a squadron with sufficient forces to recover them, and, proving successful, afterwards parcelled them out to proprietors. It was then that William Penn obtained a grant of the town of Newcastle or Delaware, with a district of twelve miles round it, which, by subsequent extensions of the grant, became the state now styled *Pennsylvania*,—a name which signifies the woody country of Penn. This gentleman was the son of Sir William Penn, a vice-admiral of England. While prosecuting his studies at Oxford, he became a convert to Quakerism, and withdrawing from the national worship, was first fined for non-conformity, and afterwards expelled the college. His father, no less displeased than his masters, treated him with great severity, and even turned him out of doors. Relenting, however, and hoping for a change, he sent him to France in company with some persons of quality. Though there he acquired a high polish of manners and various secular accomplishments, he still retained his original impressions. Accordingly, when, after his return, his father committed to him a considerable estate in Ireland, he was soon found in a Quaker-meeting at Cork, and with many others cast into prison. Being released by the intervention of the Earl of Orrery, he was recalled by his father, who remonstrated with him, but finding him inflexible, banished him a second time from his house. On this he became a public preacher among the Quakers, and wrote in defence of their tenets. He seems to have suffered no small degree of persecution, having been twice committed to Newgate, and compelled to seek a temporary refuge in Holland and Germany. At last his father became perfectly reconciled to him, and left him his paternal and large estates. In 1681, King Charles II. confirmed to him the property of the province of Delaware, in consideration of the services of his father, and several debts due to him from the crown at the time of his decease. Penn forthwith published an account of the province, with the king's patent, proposing easy terms to such settlers as might be disposed to go over. Many in consequence emigrated, chiefly Quakers and other dissenters; the plantations prospered, the town of Philadelphia was planned and built; and Penn himself drew up the fundamental constitution of the state in twenty-four articles. He was elected a member of the Royal society in 1581, and next year embarked for Pennsylvania, where he remained two years, and then returned to England. He went over again in 1699 with his wife and family, but returned in 1701. Not satisfied with the title granted by the king and his brother, he caused the lands to be purchased from the Indians for a valuable consideration, and established a treaty of peace with their chiefs. Whatever his religious impressions were, he is universally acknowledged to have been a man of liberal views, a wise and enlightened legislator. The subsequent fates of the colony belong to the general history of America. See AMERICA.

PENNY, an ancient English coin, which till of late years was dwindled into a money of account, containing the twelfth part of a shilling. In the year 1797 were first coined in this country penny-pieces and twopenny pieces of copper. See MONEY.

PENNYWEIGHT was in former times the exact weight of a penny, whence it derived the name. This subdivision of the pound Troy contains 24 grains; 20 penny weights are an ounce and 240 a pound.

PENRITH, a town of Cumberland, seated under a hill called Penrith-Fell, near the river Eamont. See CUMBERLAND.

PENRYN, a borough in Cornwall, seated on a creek of Falmouth haven. See CORNWALL.

PENSACOLA, the capital of West Florida, situate on a bay of the gulph of Mexico, in west longitude 87° 14′, and north latitude 30° 24′. It is of an oblong form about one mile in length and a quarter of a mile in breadth. The entrance into the bay is defended by a small fort and a battery. Pensacola was established by the French, and ceded to Great Britain in 1763. By the treaty of 1783, the town, with the whole of West Florida, was confirmed to the Spaniards.

PENSION, a sum of money paid yearly for services or considerations already past; and the person who receives such yearly allowance from government is called a pensioner. The band of Gentlemen-pensioners are paid an annual pension of L.100. This band, consisting of 40 gentlemen, was first instituted by Henry VII. These pensioners attend the king's person with their battle-axes to and from his royal chapel, and receive him in the presence-chamber, or coming out of his privy lodgings; they likewise attend at coronations and other great solemnities, and are each obliged to keep three double horses and a servant. They have the honour to carry up the sovereign's dinner on the coronation day and St George's feast; at which times the king or queen generally confers the honour of knighthood on two such gentlemen of the honourable band as their captain may present. The arms of the band of Gentlemen-pensioners are battle-axes; and the weapons they carry on horseback in time of war are cuirassiers arms, with sword and pistols. Their standard in time of war is, argent, a cross gules. The captain of the band is always a nobleman, who has under him a lieutenant, a standard-bearer, a clerk of the check, secretary, paymaster, and harbinger.

PENSIONER, in the university of Cambridge and in that of Dublin, applies to those students, either under-graduates or bachelors of arts, who live wholly at their own expense, and who receive no emolument whatever from the college.

PENTAGRAPH, PANTOGRAPH, or PANTOGRAPHER, a useful instrument for drawing designs of any kind in any proportion. Scheiner first described it in a tract, *Pantographiæ, sive Ars nova delineandi.*

PENTAMETER, in ancient poetry, a kind of verse consisting of five feet, or measures, and which, subjoined to a hexameter, constitutes what is denominated elegiac.

PENTANDRIA, the fifth class of the Linnæan system of classification. It is a very large class, consisting of plants which have hermaphrodite flowers with five stamens.

PENTATEUCH, a term from the Greek, signifying *five*, and an instrument or volume, applies to the first five books of the Old Testament, namely, Genesis, Exodus, Leviticus, Numbers, and Deuteronomy, written by Moses. See MOSES and RELIGION.

PENTECOST, a solemn festival of the Jews, which was celebrated on the fiftieth day after the 16th of Nisan, which was the second day of the Passover. This festival was instituted in memory of the laws being given on the fiftieth day after the Israelites came out of Egypt. From its being kept seven weeks after the Passover, the Hebrews called it the Feast of weeks.

On the feast of Pentecost, the Holy Ghost descended miraculously on the Apostles, in commemoration of which event one of the solemn festivals of the church is observed. See WHITSUNTIDE.

PENTLAND FRITH, a strait that divides the Orkney islands from Caithness in Scotland. This strait is 24 miles in length and from 10 to 15 in breadth. The navigation of this pass is very dangerous to such as are unacquainted with its tides and currents, especially in passing the island of Stroma, and a cluster of rocks named the Skerries lying at the east end of the frith. There is a lighthouse on one of these rocks.

PENUMBRA, signifies a partial shade observed between the perfect shadow and the full light in an eclipse. The penumbra arises from the magnitude of the sun's body, for were he only a luminous point the shadow would be all perfect; but by reason of the diameter of the sun, it happens that a place which is not illuminated by the whole body of the sun does yet receive rays from a part thereof. See ASTRONOMY.

PENZANCE, a maritime town of Cornwall, situated on the north-west side of Mounts' Bay, 287 miles from London and 10 from the Land's-End. See Cornwall.

PEPPER, an aromatic fruit, the genus pepper of Linnæus, (See Botany.) Pepper is produced in several parts of the East Indies, chiefly Java, Sumatra, Malacca, and the coasts of Malabar. Black pepper is of a hot dry quality, and white pepper is the fruit of the same plant with the black, and prepared from it by taking off the outer bark. Pepper which is sold ground is not unfrequently sophisticated, the black with burnt crust of bread, &c. the white with beaten rice. Long pepper is so denominated from its form, which is cylindrical, about one inch and a half in length and of the thickness of a large goose quill. It is hotter and more pungent than the black pepper, and its chief use is in medicine. Guinea pepper is of a red colour, and of an extremely pungent and acrimonious taste; its principal use is at table. A species of this pepper is the basis of the powder brought from the West Indies, and sold under the name of Cayenne pepper. Jamaica pepper is the fruit of a tree growing plentifully in Jamaica and other American islands. It is a real aromatic, and may supply the defect of cloves, nutmegs, and cinnamon; whence it is called allspice, and sometimes pimento. This pepper is considered the best and most temperate, mild, and innocent of common spices; promoting digestion, and strengthening the stomach. In the East Indies pepper is accounted a stomachic, and it is usual to drink a strong infusion of it in water to produce an appetite. A fiery spirit is also made of fermented fresh pepper with water, which is used for the same purpose; and the common and long pepper are preserved in vinegar, to be eaten at meals.

PERAMBULATOR, an instrument for measuring distances, also called odometer, pedometer, waywiser, and surveying-wheel.

PERCHLORIDE of Phosphorus, a substance obtained by introducing phosphorus into chlorine gas. This substance, together with the protochloride of phosphorus, was named phosphorane by Sir Humphrey Davy, the discoverer. See Chemistry.

PERCUSSION, the impression a body makes in falling or striking upon another, or the shock or collision of two bodies which meeting together alter each others motion. See Mechanics.

PERFECT NUMBER, a number which is equal to the sum of all its divisors. For example 6 is a perfect number, its aliquot parts being 1, 2, and 3; and $1 + 2 + 3 = 6$. Numbers which are greater or less than the sum of their aliquot parts are denominated imperfect numbers. See Number.

PERFUME, a term used to denote the volatile effluvia from any body affecting the organ of smelling, or the substance emitting those effluvia. Perfumes in general are made of musk, ambergris, civet, rose and cedar woods, orange flowers, jessamines, jonquils, tuberoses, and other flowers of an odoriferous nature. Aromatic drugs, such as storax, frankincense, benzoin, cloves, mace, &c. enter the composition of a perfume; and some perfumes are composed of aromatic herbs or leaves, as lavender, marjoram, sage, thyme, and hyssop. Among the ancients, perfumes were in general use; but since the belief has generally obtained that they are injurious to the head, they are not much used in this country. In Spain and Italy perfumes are in general use.

PERGAMUS, anciently a kingdom of Asia, formed out of the ruins of the empire of Alexander the Great. This kingdom commenced about the year A. C. 283. While the Roman empire lasted, the country remained subject to that people. It is now in the hands of the Turks.

PERGAMUS, a celebrated city of the ancient kingdom of the same name, was built at the foot of a rock, in the form of a cone, upon which was a fortified castle, where the treasures of the ancient kings were deposited. By the commerce of parchment, which was here invented, and by the fabric of stuffs and tapestry, this city accumulated immense wealth. The Olympic, Pythic, and Actian games were celebrated in Pergamus with great magnificence. Pallas, Hercules, Jupiter, and especially Esculapius, were divinities held in great respect at Pergamus; and Apollo, who was considered as the father of Esculapius, received extraordinary honours. At Pergamus, divine honours were paid to Trajan, and temples were erected to both the gods and the emperors. The temple of Augustus was constructed at the expense of the province of Asia; the Pagoda, which is represented on many medals, had eight columns. The Nicephorum, or wood, consecrated to Jupiter, was held in great veneration in Pergamus. This city is still known by the name of Pergamo. It is not so considerable as formerly, but has nine mosques, and occupies an oblong circuit of three miles. It is inhabited by about 3000 Turks, and a few Christians. Pergamus, or Pergamo, is seated on the Germasti, 15 miles from its mouth, and 37 north of Smyrna. E. Long. 27°. 27′. N. Lat. 30°. 3′.

PERIÆCI, Periœci, or Perœcians, those who live under the same parallel of latitude, but in opposite points of it, or who live under the same parallel of latitude but under opposite meridians. The Periæci, for example, to the inhabitants of London, are those who occupy the isle of Amtschitka, one of the Fox islands, a group extending from Kamtschatka to the western coast of America. The Periæci have opposite hours, that is, when it is morning with the one it is evening with the other, and when it is noon with the one it is midnight with the other; but they have the same seasons, and the same length of days and nights. The inhabitants (if any) of the poles, can have no Periæci. See Geography.

PERIAGUA, a kind of canoe, composed of the trunks of two trees, hollowed and united together. It is made use of in the Leeward islands, South America, and the Gulph of Mexico.

PERICLES, a celebrated statesman of ancient Greece, who was so brave and so eloquent that he almost gained as great an authority under the republican form of government of Athens, as if he had been a sovereign. He was born at Athens, the son of General Xantippus, and was brought up under the tuition of Zeno, Eleates, and Anaxagoras. His family connections were with the aristocracy. Being sensible, however, of the jealousy with which the body of the people viewed this party, and finding that Cimon already occupied the post of head of the nobility, he at first declined interfering with public affairs, and employed his talents in endeavouring to obtain the favour of the democracy; and as he was not a member of the court of the Areopagus, he exerted himself to lessen its authority. When the popular party had procured the impeachment of Cimon, Pericles was appointed one of the conductors, on which occasion he behaved with that moderation for which he was so remarkable in early life. To his ambitious pursuits, the exile of his rival gave ample scope. Pericles exposed himself to imminent danger at the battle of Tanagra, in the war between the Athenians and Lacedæmonians; and, with a fleet and small body of troops, he afterwards proved successful in his invasion of the Peloponnesus. He proposed a decree for the recal of Cimon, when he found the people desirous of his return. Pericles became highly popular among the Athenians after the death of Cimon. In sending out new colonies, or engaging in expeditions, he occupied the attention of the people; and by public works which he set on foot, he provided employment for mechanics and artists. In the year 417, he made himself master of Eubœa, and not long after he concluded a truce of thirty years with the Lacedæmonians. His authority became still more overbearing when Thucydides was sentenced to banishment, and at length excited the jealousy of the Athenians, insomuch that several of his friends were prosecuted. Pericles was the cause of the Peloponnesian war, by persuading the Athenians to reject the conditions of the Spartans, when they sent demands of reparation of injuries to Athens.

The memorable plague of Athens commenced in the year 423; and in the distress that ensued, the fortitude of Pericles was scarcely able to support his own spirits, or infuse courage into the hearts of his countrymen. He was afterwards subjected to many mortifications; but it was not till he was overwhelmed by domestic calamity and public disaster, that his firmness forsook him. Almost all his relations and intimate friends were carried off by the plague, of which he himself also died in the year A. C. 429. The administration of Pericles is remarkable for the grand decorations it conferred on Athens, which obtained for that city the character of refined art, retained by her after she had lost her political distinction. But, by fostering an undue spirit of ambition in his countrymen, he was the cause of many disasters.

PERIGORD, a late province of France, which now forms the department of Dordogne.

PERIOD, a term used by astronomers to denote the time taken up by a star or planet in making a revolution round the sun, or the duration of its course till it returns to the same point of its orbit. Period, in chronology, signifies a revolution of a certain number of years, or a series of years, whereby time is measured. See ASTRONOMY, and *Chronology* under HISTORY.

PERIODIC, or PERIODICAL, something that terminates and comprehends a period, as a periodic month, which is the space of time wherein the moon dispatches her period. The term is used in reference to whatever occurs regularly at equal intervals, and at stated times. Thus, there are periodical winds, as the monsoons, which blow half the year from one point of the compass, and the other half from the opposite point. Periodical publications are of various kinds, as newspapers, which appear daily, or weekly; magazines, reviews, &c. published monthly or quarterly; almanacks, ephemerides, &c. published yearly. See SCIENTIFIC and LITERARY JOURNALS.

PERIPATETICS, the appellation of a sect of philosophers who maintained the doctrines of Aristotle. According to some, this sect was so named, because they were taught in a part of the Lyceum called Paripaton; but, according to others, the name was derived from the Greek word signifying *to walk about*, alluding to the circumstances of their receiving the philosopher's lectures not in a standing, sitting, or reclining posture, but walking.

PERIPHRASIS, a term of the same import with circumlocution, implying a circuit of words, to avoid common trite modes of expression. See LANGUAGE.

PERISCII, the inhabitants of the two frigid zones, where the sun, when he is above the horizon, moves only round about them, without setting, and consequently their shadows, in the same day, turn to all the points of the horizon.

PERISTYLE, a term anciently applied to a building encompassed with a row of columns on the inside, but used by modern writers for a range of columns either within or without a building.

PERITROCHIUM, one of the mechanical powers, being a wheel, or circle, concentric with the base of a cylinder, and moveable together with it about an axis. See MECHANICS.

PERJURY, in law, the falsely taking a lawful oath. To make an offence perjury, it must appear to be wilful and deliberate, and not done through surprise or inadvertency; it must be direct and positive, and not where a person thinks or believes. When a person swears to what he is ignorant of, the oath is false, even though it should happen to be true. For example, suppose a plaintiff caused two persons to swear to the value of goods, which they had never seen, in that case, though they swore to what was true, it was, nevertheless adjudged to be perjury in them. Perjury, at the common law, is punished by fine, imprisonment, pillory, or transportation.

PERIZZITES, the ancient inhabitants of Palestine, mixed with the Canaanites. The term signifies scattered or dispersed; and the Perizzites were so called because they had no fixed habitations. Some of them were on both sides of the river Jordan, in the mountains and in the plains.

PERMUTATIONS of quantities, in arithmetic, a rule for ascertaining how many ways the order of a given number of things may be varied, which is as follows: Multiply the terms of the natural series of numbers, from one up to the given number, continually together; the last product will be the answer required.

PERNAMBUCO, or FERNAMBUCO, a government of Brazil, in South America, separated from that of Seregippa, on the south, by the river St Francis. It is productive of excellent cotton, sugar, and brazil wood, and its vast plains afford pasture for a great number of cattle. The Dutch became possessed of it in the year 1630, but the Portuguese re-took it some time after.

*Pernambuco*, the capital of the government of the same name in South America, is a place of considerable trade. It is sometimes called Recife, and consists of three towns, Recife, St Antonio, and Boa Vista. The middle division, namely, St Antonio, includes the governor's palace, together with other public edifices, and is connected by a bridge on the west side to Boa Vista, and by another on the east to Recife, which latter place is nearly surrounded by the inner harbour, which is guarded from the sea by a reef of rocks. Large vessels can anchor only in the outer harbour, which extends three miles north to the town of Olindo, and is rather exposed to the ocean.

PERONNE, a strong town of France, in the department of Somme, is seated on the river Somme, 80 miles north by east from Paris. It is also called *Pucelle*, from the circumstance of its having never been taken, though frequently besieged. In the castle of Peronne, Charles the Simple died miserably while confined as a prisoner; here also the duke of Burgundy detained Louis XI. three days, till he consented to sign a disadvantageous treaty.

PERORATION signifies the epilogue, or last part of an oration, wherein is passionately urged what the orator, through his whole discourse, had insisted upon. It consists first of recapitulation, and second of moving the passions. Peroration was the master-piece of Cicero, who never had an equal in this part of an orator's province. Dr Blair, in his Lectures on Belles Lettres, observes, that in all discourses it is a matter of importance to hit the precise time of concluding, so as to bring our discourse just to a point neither ending abruptly and unexpectedly, nor disappointing the expectation of the hearers when they look for the close, and continuing to hover round the conclusion till they become heartily tired of us. He should endeavour to go off with a good grace, not to end with a languishing and drawling sentence, but to close with dignity and spirit, that he may leave the minds of the hearers warm, and dismiss them with a favourable impression of the subject and of the speaker.

PEROUSE, or PEYROUSE, J. F. G. de La, a distinguished French navigator, was born in the year 1741 at Toulouse. While very young, he was sent by his father to the marine school, where he made considerable progress in his education, and became strongly attached to the naval profession. In 1756, he was appointed a midshipman, in which station he behaved with great bravery, and was severely wounded in the engagement between Hawke and Conflans in November 1759. He was made a lieutenant in 1764, and was raised to the rank of master and commander in 1767. He commanded the Amazon belonging to the squadron of Vice-Admiral D'Estaing in 1779; and when that officer engaged Admiral Byron, our hero's post was to carry the orders of the admiral to the whole of the line. La Perouse took the sloop Ariel some time afterwards, and assisted in the capture of the Experiment. He was sent in 1782 to destroy the English settlements in Hudson's bay, which he effectually accomplished.

In the year 1785, an expedition of discovery was fitted out by the French government, and to La Perouse was committed the command of the Boussole and Astrolabe, with which he sailed from Brest, and anchored the same year on the Brazil coast. The expedition proceeded round Cape Horn, anchored in the bay of Conception in 1786, and afterwards directed their course to the Sandwich islands. They anchored on the American coast in latitude 58° 37′, ran down to California, crossed the Pacific, and reached Macao in 1787. At Manilla they touched shortly after, and, passing the coasts of Corea and Japan, they arrived at Chinese Tartary, in latitude 42½°. Having anchored in a bay in Sagalien island, they proceeded up the Narrow Channel, as far as 51° 29′. They on their return passed by La Perouse's strait between Sagalien and Jesso, into the Northern Pacific. In the harbour of St Peter and St Paul, in Kamtschatka, they anchored, and after refitting proceeded to Navigator's Islands, and thence to New Holland, and arrived at Botany Bay in January 1787. The last dispatches of La Perouse were dated from Botany Bay, February 7, 1788; but of the fate of the expedition no farther accounts have ever been received which are entitled to any credit.

In 1798, was published, in 3 vols. 4to, the Journal which La Perouse transmitted to France. It appears that this navigator was remarkably well qualified to discharge the important trust in which he had engaged. He was an experienced and skilful seaman, a man of mathematical and physical science, and to these valuable qualifications he added caution and courage, with a truly benevolent disposition towards the savages whom he visited.

PERPENDICULAR, in geometry, a line falling directly on another line, so as to make equal angles on each side, called also a normal line. If one line be perpendicular to another, this last is likewise perpendicular to the first. From the same point, whether it be within or without the given line, there can be only one line drawn perpendicular to the given line. If a perpendicular be drawn to a given line, and produced on the other side of it, the part produced will likewise be the perpendicular to the given line. Every right line that is perpendicular to another right line is also perpendicular to all the lines that are parallel to the latter. A perpendicular is the shortest line that can be drawn from a given point to any line or plane. Hence the distance of a point from a line or plane, is the line drawn from that point perpendicularly to the said line or plane: also the altitude of a figure is the perpendicular let fall from the vertex to the base.

PERPETUAL MOTION, a motion that is supplied from itself, without the intervention of any external force, excepting only that of gravity. For more than two thousand years this problem, which M. De la Hire and others consider absurd, has engaged the attention of mathematicians. Many machines, said to possess the property of perpetual motion, have from time to time appeared; but every project of this kind has proved abortive, so that no useful result has been obtained. See MECHANICS.

PERPETUAL or ENDLESS SCREW, a screw that works in the cogs of a wheel, such as the screw on the axis of the fly wheel of a common roasting jack. See MECHANICS.

PERPIGNAN, a fortified town of France, seated on the Tet, near the Mediterranean, 95 miles southeast of Toulouse. It is the capital of the department of the Eastern Pyrenees, and has a good citadel and a university.

PERRAULT, CLAUDE, born at Paris in the year 1613, and bred a physician; which profession, however, he quitted, for that of an architect. He excelled in all those arts which relate to designing and mechanics; and when the academy of Sciences was instituted, he was one of its first and most useful members. He designed the entrance to the Louvre; published a Translation of Vitruvius into French, with notes; a book of the Five Orders of Architecture; a collection of several Machines of his own invention; Medical Essays; and Memoirs of the Natural History of Animals. He died in 1688.

PERRAULT, CHARLES, brother of Claude, a celebrated French poet and miscellaneous writer, born 1626, died 1703. He was one of the first members of the academy of the Belles Lettres and Inscriptions, and was received into the French academy in 1671.

PERRY, an agreeable and wholesome liquor extracted from pears, in a manner similar to that by which cider is extracted from apples. See BREWING.

PERSECUTION, the act of persecuting, or, in in a more restricted sense, the sufferings of Christians on account of their religion. Ten general persecutions are particularly mentioned by historical writers. Of these, the first was under Nero, 31 years after our Lord's ascension; when that bloody emperor, having set fire to the city of Rome, threw the odium of that diabolical action on the Christians, under which pretence many of them were wrapped up in the skins of wild beasts, and worried and devoured by dogs, and others were crucified or burned alive. In the year 95, Domitian commenced a cruel persecution of the Christians, who were declared enemies of the state. In this persecution, great numbers were banished or put to death; and among the number of the exiled was St John the apostle, who was banished to the isle of Patmos, where he wrote the book of the Revelations. The third, which was carried on with great violence, began under Trajan in the year 100. Under the emperor Antoninus, the fourth persecution commenced, when the Christians were driven from their habitations, forbidden to shew their heads, and treated with the greatest cruelty. The fifth began under the emperor Severus, A. D. 197. With the reign of the emperor Maximus the sixth persecution commenced, in the year 235. The most horrid persecution that had ever been known in the church, began in the reign of the emperor Decius, A. D. 250, when the Christians were banished from their houses, reproached, plundered, imprisoned, and tormented on racks. In the year 257, began the eighth persecution under the emperor Valerian. The ninth, which was not very considerable, happened in the year 274. The tenth persecution began, A. D. 303, and was encouraged and promoted by Dioclesian. It continued ten years, during which period the most execrable cruelties were exercised upon the Christians; houses filled with them were devoted to the flames, and numbers were tied together with ropes and thrown into the sea.

PERSEES, or PARSEES, the descendants of a colony of ancient Persians, who, when their own country was conquered by the Mahometan Arabs, took refuge at Bombay, Surat, and in the vicinity of those cities. See GABRES.

PERSEPOLIS, the ancient capital of the empire of Persia, remarkable for its magnificent ruins, which are situated at the bottom of a mountain, fronting south-west, about 40 miles to the north of Shiraz. This renowned city stood in a considerable plain, the entrance of which, on the west, exhibits much natural grandeur, and consists of a range of steep and high mountains, four leagues in length, and about two miles broad, forming two flat banks, with a rising terrace in the middle, whose summit is quite plain and even. There were within the compass of this plain between 1000 and 1500 villages, all adorned with pleasant gardens, and planted with shady trees. A considerable part of the ruins of Persepolis are encircled by the mountain Rehumut, in the form of an amphitheatre. A grand staircase of blue stone, containing 104 steps, forms the ascent to the columns. On his entrance, the traveller is delighted with the appearance of two portals of stone, about 50 feet in height each, the sides of which are embellished with two sphinxes of vast size, and, contrary to the usual method, represented standing. There are inscriptions on the sides above, which being in an ancient character cannot be deciphered. A flight of steps at a small distance from the portals leads to the grand hall of columns. At the head of this staircase, which is magnificently adorned with various figures in basso relievo, appear inscriptions in ancient characters. On getting to the top of this staircase, the traveller enters what was once a superb hall, and to which the name *chehul minar*, or forty pillars, is applied by the natives. Of these ancient columns fifteen yet remain entire; they are from 70 to 80 feet in height, and their pedestals, which are wrought in a curious manner, seem little injured by the hand of time. The shafts are fluted to the top, and the capitals are richly ornamented with fretwork. The next object of attraction is the remains of a considerable edifice, which is entered through a door of granite. The greater part of the doors and windows of this apartment are still standing; they are of black marble, and polished like a mirror. At the south-west entrance of this apartment appear two large stone pillars, whereon four curious figures are carved. The remains of a staircase, of blue stone, are likewise still visible at this entrance. Over a considerable extent of ground are scattered broken pieces of pillars, shafts, and capitals, some of them of very extraordinary size. The whole of these ruins, though they are now the shelter of beasts and birds of prey, afford sufficient evidence of the grandeur and magnificence of the ancient capital of Persia. There are inscriptions, besides those above-mentioned, in Arabic, Persian, and Greek. Dr Hyde informs us, that the inscriptions are executed in a rude and clumsy style, and that some of them are in praise of Alexander the Great, so that they must be later than that conqueror.

PERSEVERANCE, in theology, denotes a continuance in a state of grace to a state of glory. See RELIGION.

PERSEUS, in fabulous history, was the son of Jupiter and Danæ, who performed a variety of exploits by means of Medusa's head, and was made a constellation. See ANDROMEDA.

PERSEUS, one of the forty-eight ancient constellations. According to Ptolemy and Tycho Brahe, it contains twenty-nine stars; but Hevelius assigns to it forty-six, and Flamsteed fifty nine. This constellation is situated in the northern hemisphere, between Auriga and Cassiopeia. On our globes and maps it is represented as a man with wings on his heels, his right arm being extended over his head with a sword in his right hand, and the head of Medusa in his left.

PERSHORE, a town in Worcestershire, seated on the river Avon, nine miles south-east of Worcester, and 106 west north-west of London. It consists chiefly of one street, about three quarters of a mile in length. The inhabitants exceed 1900; the greater part of whom are employed in the stocking manufactories. In the size and population of this place, a considerable increase has been occasioned, owing to the road from London to Worcester passing through it. Pershore has two churches, and that of Holy Cross contains several ancient monuments. The parish is extensive.

PERSIA, an ancient and celebrated empire in Asia, the boundaries of which have undergone many changes. It lies between the 26th and 40th degrees of north latitude, and the 45th and 61st degrees of east longitude. The name Persia spread, from the province of *Pars* or *Fars*, throughout the empire. Both in ancient and modern times, however, the natives have termed their country *Iran*; and the countries subject to Persia beyond the river Gihon or Amu, were anciently named *Aniran*. Persia may, in general terms, be said to be bounded on the north by the Caspian sea and the river Kur, on the east by the waters of the Gihon and Indus, on the south by the Persian gulf and the Indian ocean, and on the west by the Tigris and Euphrates. It is now divided into two independent monarchies, Western Persia, constituting the dominions of the present king of Persia, and Eastern Persia, or Afghanistan, governed by the chief of the Afghans or Afghauns. Their particular boundaries are not correctly ascertained, and in their physical, civil, and political character they differ considerably. Western Persia, to an account of which this article is limited, comprehends the provinces of Fars, Irak, part of Kurdistan, Adeibijan, Laristan, Kusistan, Ghilan, Mazenderan, the western parts of Khorassan, and the western division of Kerman, including the capital of that province. The principal city is Ispahan, (already noticed,) which was formerly the capital of the empire; but the royal residence has been of late transferred to Teheran.

*General aspect.*—As this country is highly elevated, it may very properly be called a land of mountains. Viewed in a general scale, one of the most remarkable features of Persia is its division into two parts by deserts and mountains; a circumstance which in all ages has greatly influenced its history and destinies. The want of rivers also forms a singular feature of the country, and except in the north and some parts of the western mountains even trees are rarely to be seen. This country joins the high lands of Armenia and Asia Minor on the west, and those of Central Asia on the east, having its declivities on the one side towards the Euphrates and Persian gulf, and on the other towards the Caspian sea.

*Mountains and Deserts.*—The mountains of Caucassus and Ararat, sometimes called the mountains of Daghestan, extend between the Euxine and Caspian seas, and those named Taurus branch through Persia from Natolia to India. Not far from the mountain Demawend, and about 40 miles from the city of Teheran, there is an artificial passage, anciently called the Caspian gates, which passage is described as a narrow road about twenty-eight Roman miles in length. The Hetzerdera, or *thousand mountains*, embrace on the north and west the city of Shiraz, and the magnificent ruins of Persepolis. Through a defile in this chain, called the Persian straits, was led the army of Alexander the Great. A chain of mountains commencing near the Persian gulf, stretches across Kerman, and joining the range that divides Seistan from Mekran, forms, with the mountains of Sooliman and those of Walli, a considerable plateau between Persia and India. Extending irregularly in all directions, many of the mountains of this country, after rising abruptly, gradually become flat at the summit, and present the appearance of a plateau.

The deserts of Persia extend over nearly three-tenths of the country; they are rather saline than sandy. The Great Salt desert is the principal. It lies between Khorassan and Irak Adjum, and joins the Caramanian desert, which forms the northern part of Kerman. These two deserts extend over about 140,000 square miles, and the salts abounding in this immense tract impregnate the adjacent lakes and rivers. Commencing on the banks of the river Keirmund, the Great Sandy desert stretches to the range of mountains dividing the province of Mekran, an extent of about 450 miles. The desert of Kara-Kum, or the Black sand, covers part of Khorassan, and constitutes the northern boundary of the country towards Tartary, and that of Kiab is situated on the east of the Tigris, whence it extends to the north of Shuster.

*Rivers and Lakes.*—There are but few rivers of any consequence in Persia. The Araxes, now called *Aras*, takes its rise in the mountains of Caucausus, and after a course of great extent forms a junction with the Kur or Cyrus. The Kizil-ozen, supposed to be the *Mardus* of the ancients, rises in the western mountains, and takes a winding course to the Caspian. It flows in a series of cataracts through picturesque ravines, and falls into the sea with such force that its current may be observed at a great distance from the shore. The river Tedzen, the ancient Ochus, after receiving several small streams from the mountains of Mazenderan, empties itself into the Caspian sea. The Zynderood takes its rise in the Baktyar mountains, and passing Ispahan loses itself in the deserts of sand to the south-east. By the rains and the melting of the snows, the waters of the Zynderood are sometimes so swollen as to overflow the banks of that river to a great extent, rendering considerable tracts of rich and productive land useless for the season. The Bendemir flows from north to south, between Shiraz and Persepolis, and falls into the salt lake Baktegan, which likewise receives another stream called the Kuren.

The lakes of Persia are similar to those of Africa. The salt lake Baktegan, situated ten miles south-east of Shiraz, is nearly dry during summer, when the salt with which the bottom is encrusted is collected. Lake Shahee, or Ormia, which lies among the mountains of Aberbijan, is remarkable for receiving fourteen rivers of different sizes without any apparent increase of its waters. This lake is about 280 miles in circumference, and its greatest depth is not more than five or six feet. Its waters yield, when evaporated, a bitter salt of a beautiful transparency, and one-third more in quantity than sea-water; these waters are said to be so prejudicial to fish, that when any are thrown into it by the rivers, they immediately die. The lake Erevan, which lies about 100 miles to the north, is 70 miles in circumference, and abounds in carp and trout.

*Climate.*—The northern provinces of Persia are comparatively cold and moist. In the centre of the kingdom the winter begins in November and continues till March, generally severe with ice and snow. In the centre and south, the air is usually dry; thunder and lightning are unfrequent; but, in the spring, hail is often destructive. Near the Persian gulf, the hot wind called *samiel* sometimes suffocates the unwary traveller.

*Soil and Agriculture, &c.*—The soil may be regarded as unfertile, and even the valleys are sometimes sandy and stony, or of a hard dry clay; hence the industry of the Persian farmer is chiefly employed in irrigating his lands. The most common grain of the country is wheat, which is excellent; but rice is a more general aliment, and considered by the Persians as the most delicious food. Barley and millet are likewise sown. On the mountainous ridges are found the cypress, the cedar, and several other kinds of pines. The sumach, whose astringent wood is so necessary to the arts of dyeing and tanning, grows here in great abundance. The fig, the pomegranate, the mulberry, almond, peach, and apricot, are indigenous fruits of the country. The vine and orange grow in great luxuriance. Both cotton and sugar are articles of common cultivation towards the south of Persia. The jessamine and the blue and scarlet anemona are found in the thickets, and the tulip and ranunculus in the pastures. The gardens of this country being cultivated with great care, are both beautiful and productive. In Khorassan are raised the most succulent melons, which are remarkable for their great size. The quinces of Ispahan are esteemed the finest in the east, and Shiraz is celebrated for excellent wine. The silk worm is cultivated extensively, and its annual produce exceeds four millions of pounds; of which quantity about a twentieth part is used in the country, and the rest is disposed of in India, Turkey, and Russia.

The Persian horses are of different breeds; they are the most beautiful even in the east, but in speed they yield to the Arabian, which are less distinguished by elegance of form. Mules are likewise in considerable request, and the ass of Persia resembles the European. The camel is also common. The cattle bear some resemblance to the European, except towards Hindostan, where they are marked by the hunch on the shoulders. Of the large tailed sheep, that appendage not unfrequently weighs upwards of thirty pounds, enlarging at the bottom in the form of a heart. The few forests contain abundance of deer and antilopes, while the mountains present wild goats. In the numerous wastes, hares are common. In the forests are chiefly concealed the ferocious animals, as the bear and boar, the lion in the western parts, with the leopard, and, according to some accounts, the common tiger. On the rocks of the Caspian, seals occur frequently. The wild ass is found in the central deserts, but to the southern provinces belong the hyena and jackall. The seas abound in various kinds of fish. The Persians have been long accustomed to tame beasts of prey, so as to hunt with leopards, panthers, and ounces. The antelope, the hare, the zebra, the fox, the argali, and deer of various kinds, afford to the sportsman ample amusement. The partridges of Persia are remarkably large and excellent, and pigeons are particularly numerous. With his varied song the oriental nightingale enlivens the spring.

*Mineralogy.*—In Persia have been found metals of almost every description. Iron, copper, and lead, have been common since the reign of Abbas the Great, but there are no mines open of gold and silver. In Kerman and Mazenderan there are silver mines, but, owing to the want of wood, they cannot be wrought. Quarries of red, black, and white marble are found near the city of Taurus. Rock salt is found near Ispahan. Whole deserts are sometimes covered with sulphur, and others with salt. Pearls abound in the Persian gulf, some of which weigh 50 grains. The only precious stone yet discovered seems to be the turquoise. In this mountainous country medical waters of various descriptions abound, but they are much neglected by the physicians as well as by the people.

The fountains of Naphtha, or pure rock oil, in the neighbourhood of Baku or Bakou, on the western coast of the Caspian, are particularly worthy of notice. See BAKOU. Persia yields white and black naphtha. The black naphtha is used by the natives as a substitute for pitch, and is also used in lamps as a substitute for oil; and the white naphtha, which bears a great resemblance to tallow, affords a superior light without emitting so disagreeable a smell as the former. Near Doulakee in the province of Fars, there are two fountains of white naphtha, where the oil floats like a crust on the surface of the water, and is collected by the natives.

*Inhabitants.*—The original population of the mountainous country of Persia seems to have been indigenous, that is, no preceding nation can be traced; and in the opinion of all the most learned and judicious enquirers, this nation is Scythic or Gothic, and the very source and fountain of all the celebrated Scythian nations that detached victorious colonies into the greater part of Europe, long before the Christian era. The ancient Medes and Persians in the north of Persia appear to have been of Sarmatic or Slavonic origin, and to have come from their native regions on the Wolga. Of the population of this country, various estimates have been made. Chardin states it to be fourteen millions, but Pinkerton reduces it to ten, including Afghanistan. According to Malte-Brun, the agricultural class amounts to more than 10,700,000, and the wandering tribes are 700,000 more, which estimate perhaps approaches as near the truth as can be ascertained.

*Manners, Customs, &c.*—The natives of this country are commonly fat, with black hair, high forehead, aquiline nose, full cheeks, and a large chin, the form of the countenance being generally oval; the ordinary complexion is fair, somewhat tinged with olive, but those in the south, and the provinces towards India, are of a dark brown. The men shave the head, and wear high crimson bonnets; but the beard is sacred, and cultivated with great care, and almost universally dyed black. It is not unusual for the natives to wear three or four light dresses, fastened round the waist with a sash, in which a small dagger is stuck; and they wear remarkably large cloaks of thick cloth; they likewise wear linen trowsers, loose boots, and slippers. They are exceedingly ostentatious in their dress, especially in the principal towns, and their garments are of chintz, silk, or cloth of a dark colour, and often trimmed with gold or silver lace, and in winter are lined with furs. The women cover the head with a large black turban, over which a Cashmerian shawl is thrown to serve as a veil; their robes are rather shorter than those of the men, and fastened in front by large buttons.

The inhabitants of Persia may be properly divided into two classes, namely, the agricultural and manufacturing class, who reside in fixed dwellings, and the wandering tribes, who live in tents and subsist by their flocks or by fishing. Very different shades of character are observable among the inhabitants of the various cities and towns of the Persian empire; but, as a people, the Persians are, generally speaking, of a lively imagination, of quick apprehension, and of very agreeable manners. Indeed they pride themselves in universal politeness; they are likewise very hospitable, though not without the expectation of receiving presents in return. They seem to consider themselves as more sagacious and wise than other nations, yet are passionate; and the recent commotions have imparted a taint of cruelty to the national character. Of a sanguine temperament, both rich and poor are generally gay; and immoderate mirth will not unfrequently succeed the most outrageous quarrels. It is the usual practice of the Persians to eat twice or thrice a day, dining about noon; but the chief repast is the supper, as with the ancient Greeks and Romans. Boiled rice is the dish most commonly in use among them, and they are remarkably fond of sweetmeats. Both in their person and habitations they are in general very cleanly. Marriages are conducted by female mediation, and the pomp and ceremonies are pretty similar to the Russian. Polygamy is permitted, but the first married is always respected as the principal wife. "In their general manners," says a late traveller, "the Persians are certainly the Parisians of the East. Whilst a rude and insolent demeanour peculiarly marks the character of the Turkish nation towards foreigners and Christians, the behaviour of the Persians would, on the contrary, do honour to the most civilized nations; they are kind, courteous, civil, and obliging to strangers, without being guided by those religious prejudices so very prevalent in every other Mahomedan nation; they are fond of inquiring after the manners and customs of Europe, and, in return, very readily afford any information respecting their own country. The practice of hospitality is with them so grand a point, that a man thinks himself highly honoured if you will enter his house and partake of what the family affords; whereas going out of a house without smoking a caleau, or taking any other refreshment, is deemed in Persia a high affront." The natives of this country do not recline on cushions, but sit in an erect position on a thick felt called a mumud. It is customary with them to rise with the sun, to take a cup of coffee, or some fruit, when they have dressed and said their prayers; after which they enter on the business of the day, or else smoke and converse. Between the hours of nine and ten, the dinner or principal meal is served up. The Persians are kind and indulgent masters, and the lower ranks excellent servants. It must be observed, however, that falsehood and duplicity sully the Persian character.

Among all ranks in this country, riding upon horseback, walking in gardens, and sitting in groupes in a house, or under the shade of a tree, listening to a tale or a poem, are the general occupations of the idle hours of the natives; and at public feasts the prevailing amusements are illuminations, fireworks, musicians, dancing boys, wrestlers, jugglers, buffoons, and puppet-shews. The usual mode of travelling in Persia is upon horseback, and the natives are remarkable for their dexterity in riding. Portable pavilions placed on camels or suspended between two mules, are the usual mode of conveyance for females.

In Persia, the women have no assigned place in the community, but are what their husbands, or rather lords, think proper to make them. Their labours and amusements are confined within the walls of the haram, where, however, they are sufficiently employed in sewing, embroidering, and spinning, making their own clothes, and sometimes those of their husband, and superintending domestic concerns. The arts of music and dancing are taught only to slaves, who practice them for the amusement of their masters.

The mosques and bagnios are the principal public buildings in Persia. The former are of a square figure, and generally built of stone, with a square court before the main-entry, paved with white marble, and having low galleries around it, whose roofs are supported by white marble pillars. In these galleries the Mahometans perform their ablutions before they go into the mosque for the purpose of devotion. Each of the mosques has six towers, with small spires, called minarets, and three little open galleries, one above another, from which a certain officer calls the people to prayers. The roofs of the mosques are commonly covered with lead, and adorned with gilding, &c. Many of them have a place of entertainment for strangers during three days; and in the neighbourhood is also the tomb of the founder, with conveniences for reading the Koran, &c. The baths are sometimes square, but more generally circular, and constructed of marble, or some other kind of stone, well polished. In each of these buildings there are three rooms; one for undressing and dressing, another for the water to be used in the bath, and the third for the bath itself,—all of them paved with black and white marble.

*Language.*—For strength, beauty, and melody, the language of Persia is, perhaps, the most remarkable of all the oriental tongues. This language bears a striking affinity to the German, though softened by the long usage of a polished people. Of Persian literature, one of the oldest remains is the celebrated Sha Nama, or History of Kings, a long heroic poem of Ferdusi. Hafiz is the Anacreon of the east, and his tomb is venerated in the vicinity of Shiraz. To his monument is chained a handsome copy of his works. Sadi, an entertaining moralist, writes in prose mingled with verse, not unlike several of the Icelandic *Sagas.* By the Persians, the sciences, in general, are but little cultivated. They are very superstitious, and are enthusiastic believers in astrology. The education of the modern Persians is principally military; and their gross flatteries and obliquity of expression indicate that they have entirely forgotten the noble system of their ancestors, who, in the first place, instructed their children to speak truth.

*Religion.*—The religion of this country is well known to be that of Mahomet, which was introduced by means of the sword, and has been followed by its usual effects, the destruction and depopulation of the country. The Persians, however, adopt a less severe system of this creed than that of the Turks and Arabs. Their native good sense and benignity of manners led them to reject several absurdities, whence they are regarded as heretics by the other Mahometans. Of the Persees, otherwise called Gabres, there seem to be no remains in Persia, except a few families in the town of Kerman and Yest. Christianity has at no time made any progress in Persia. In the mountains of Kurdistan, a colony of Nestorians has long been established. The Jews in Persia are held in utter contempt, but the Armenians enjoy the free exercise of their religion.

*Manufactures and Commerce.*—The manufactures and commerce of the Persian empire may, in a great measure, be said to be annihilated, though a few carpets still reach Europe at extravagant prices. The natives of this country excel in cutting precious stones, and in dyeing bright and lasting colours; and their cotton and woollen cloths, as well as that made of camels hair, together with their velvets, silks, and brocades, are superior manufactures. The bows made by them are the most esteemed of all in the east, and the sabres are beautifully damasked.

*Government.*—The government of Persia being despotic, the lives and the estates of the people are entirely at the disposal of the prince. Indeed the state of the people seems to be deplorable, as they are subject to the arbitrary power and extortions of the numerous khans or chiefs. The jurisprudence of Persia is founded on the doctrines of the Koran. The nominal judge of criminal law is the schiek ool islam; but in cases of importance the governors of the different towns and provinces usually decide. The king himself daily sits in judgment in the capital, and the award is by no means uniformly consonant to justice. The general punishments to men of rank are death and privation of sight, and to those of the lower orders mutilation and the bastinado on the soles of the feet. In the punishment of the crime of theft, the most unrelenting severity is exercised.

The laws of Persia exclude females from the throne, and blindness is another disqualification, for which reason it is common for a brother who ascends the throne to put out the eyes of all the rest of his male relations, nay, it has sometimes happened that a father has put out the eyes of his eldest son, to prefer the younger who was his favourite. The emperor has no councillors, except those favourites who have art enough to engage his attention by their services or flatteries; and their situation is certainly very precarious, as the least deviation from his will, or perhaps a secret calumny, will undoubtedly cost them their lives. In Persia there are no degrees of nobility.

*Army and Revenue.*—The number and bravery of the wandering tribes constitutes the military force of the Persian empire. The standing army, as it may be denominated, consists of the body-guard of the king, amounting to about 10,000 men, and the gholaums, or royal slaves, who are about 3000. When an army is required to be raised, the chiefs of the different tribes are, by the sovereign, commanded to camp a number of men proportioned to the power and strength of each tribe. The revenue of this country is said to amount to about six millions Sterling. It is derived from the following sources: The maleeat, or fixed revenue; the sadir, or contribution; and the peish-kesh, or voluntary gift. The receipts of the government greatly exceed the disbursements; the policy of this, as of all other oriental states, being to amass wealth.

*Royal titles and arms.*—The Persian monarch is styled Shah, or the disposer of kingdoms, and he likewise takes those of Khan and Sultan, which are derived from the Tartars. He never signs his name to any public act,—but all acts conclude, *this act is given by him whom the universe obeys.* His arms are a lion couchant looking at the rising sun.

*History.*—The early history of this country is involved in great obscurity. Chedorlaomer, who conquered many Asiatic provinces, is the first mentioned king. Afterwards nothing extraordinary occurs till the time of Cyrus, the founder of that great empire which was the glory and terror of the east. According to the Greek historian Xenophon, this great conqueror was the son of Cambyses king of Media, In his time the son of the king of Babylon having provoked some of his Median nobility, a war ensued, which terminated in the destruction of the Babylonish empire. (See BABYLON.) Cyaxeres, uncle to Cyrus, headed the malcontents, and the latter had in this war to encounter not only the Babylonians but likewise the combined forces of all the nations of Asia Minor, who had joined the king of Babylon either as subjects or allies. In addition to these there were 120,000 Egyptians, the whole making an army of 420,000 men, while the army of Cyrus amounted only to 190,000 men. In an extensive plain near Thymbra the two armies engaged; and both having sufficient room to act, Crœsus, king of Lydia, who commanded the allied army, availed himself of his superiority in numbers, by surrounding the Persians. The allies, however, were routed with great slaughter, Sardis, the capital of Lydia, and Crœsus himself were taken, and consequently no farther obstacle remained from the nations of Asia Minor.

After this pitched battle, which is the first we find particularly described by any profane writer, Cyrus marched directly against Babylon, which he reduced; and having settled the affairs of his empire in peace, he extended his dominion over all the countries from the river Indus to the Egean sea, making the Caspian and Euxine seas his boundary on the north and north east, Ethiopia and Arabia to the south and west. His son Cambyses, who proved a vile tyrant, made a partial conquest of Egypt, but lost in the deserts of Arabia an army of 50,000 men all of whom were buried by the moving sands, as they proceeded with the design of destroying the temple of Jupiter-Ammon. He had nearly perished, with famine, at the head of an expedition against the Ethiopians, and great numbers of his people actually were lost. The Persian empire may therefore be said to have declined under Cambyses, but it revived under Darius Hystaspes, who about 522 B. C. ascended the throne.

The reign of this prince is famous for the reduction of the Babylonians who had revolted, and for the conquest of India. His prosperity, however, was severely checked by an unfortunate expedition against Scythia, and another against Greece. Xerxes, his successor, was also very unfortunate; for in an expedition against Greece, he lost the greatest army ever recorded in history. (See GREECE.) The only exploit of this prince was to reduce and oppress the Egyptians; but he latterly became weary of all martial expeditions, and tyrannized over his subjects. He was assassinated B. C. 464.

Artaxerxes Longimanus, the Ahasuerus of Scripture, was the successor of Xerxes. Under him the affairs of the empire prospered tolerably, and the Egyptians who had revolted were again reduced to obedience. After his death internal dissensions arose, when the invasions of the Greeks threatened to destroy the whole fabric. The most dangerous rebellion was that of Cyrus the younger, against his brother Artaxerxes Mnemon. By his father he had been entrusted with the command of all the provinces of Asia Minor, and he was thus enabled to raise an army of 100,000 men, which, with 13,000 Greek mercenaries, were sufficient to have put him in possession of the crown of Persia. The matter was decided at a place called Cunaxa in the province of Babylon, where Cyrus, through his extreme impetuosity, lost in a single combat at once hopes of the kingdom and of his life. The Asiatics who served him were discomfited, but the Greeks proved invincible, and made their way to their own country, notwithstanding the utmost efforts of the enemy. They were in this celebrated retreat commanded by Xenophon, who brought 10,000 safe into Greece.

So apparent did the inferiority of the Persians, in comparison of the Greeks, at length become, that a plan of conquering the whole empire seems to have been projected by the Lacedæmonians. For this war the pretence was, that the Greek cities in Asia were oppressed by the Persians; but it was carried on with such excessive animosity, and reasonable terms of peace were so often refused, that there evidently was some other design than the restoration of liberty to their cities. Finding that peace was not to be obtained upon any terms, Artaxerxes was induced to bribe the other Grecian states to enter into a combination against the Lacedæmonians, which was done in a manner so effectual, that Agesilaus their king was under the necessity of abandoning his conquests and returning to his own country. Meantime, however, the Persians having fitted out a powerful fleet, the command of which was committed to Conon an Athenian, were enabled to cope with the Spartans at sea, and not content with giving them an entire defeat, in which were taken fifty of their ships, the admiral not long after made a descent on the coast of Laconia itself, ravaging and plundering all the maritime coasts.

The Spartans were by these misfortunes obliged to abandon all thoughts of conquest, and likewise to conclude a peace upon terms very disadvantageous; and Artaxerxes obtained a superiority over the Greeks, which it had been well for the empire had his successors not been careful to maintain. Having freed himself from these dangerous enemies, he attacked and reduced the island of Cyprus. But he was unfortunate in an expedition against the Caducians and Egyptians whom he found it impracticable to reduce.

The successor of Artaxerxes Mnemon, was Ochus, a most cruel and bloody tyrant, who, notwithstanding, shewed himself not unskilful in military affairs. This prince made war against the Sidonians, whom he reduced to such a state of despair that they burnt themselves in their own houses to the number of 40,000. After this he fitted out an expedition against the Egyptians, and reduced them to the most abject slavery, not only dismantling their cities and fortresses, but plundering their temples, carrying off their records, and destroying their sacred animals. He was, for this sacrilege, murdered by an Egyptian eunuch, of the name of Bagoas, whom he had taken into favour. Not content with putting an end to his life, the assassin procured another body to be buried instead of that of Ochus, gave his flesh to be devoured by cats, and, it is said, made handles to swords of his bones.

This individul having, by the destruction of his master, attained in fact to the supreme power, took upon himself to raise up and pull down sovereigns as he thought proper. He first elevated to the throne Aries, the late king's youngest son, and he soon after poisoned him, in order to prefer Darius Codomanus. Darius, he designed, ere long, to have destroyed in the same manner as he had done Aries; but that prince being on his guard, obliged Bagoas to drink the poison he himself had prepared, by which precaution he established himself on the throne in as much as security from internal enemies could do so; but this was scarcely accomplished, when Alexander the Great invaded and conquered his dominions. Of this monarch's conquests the rapidity was unequalled. In every battle they fought his armies were victorious, and in every siege undertaken by them they proved successful. Three great battles, at Granicus, Issus, and Arbela, decided the fate of the empire of Persia; and being by the last put in possession of *Persepolis*, the capital, Alexander there sullied his conquests by burning the palaces, plundering the town, and committing many other acts of barbarous cruelty. Darius had still an army of 80,000 foot, among whom were 4000 Greeks, who, notwithstanding his misfortunes, had continued faithful to him. He fled with these towards Media, but was murdered by his own people, and the whole empire became subject to Alexander.

On the division of his empire, Persia fell to the lot of Seleucus Nicator, and was held by him and his successors on the throne of Syria till the time of Antiochus Theus, about 250 years B. C. In his time the Parthians who occupied the country now called Eyrac Agemi, being exasperated by the tyrannical conduct of their governor, revolted under one Arsaces, whom the Syrian monarchs were unable to overcome. He reduced Hyrcania and some other provinces under his power, but was at last killed in a battle against Ariarathes IV. king of Cappadocia. The successors of Arsaces conquered not only Persia but many other countries of the east, extending their dominions farther than Alexander had done. In short, the Parthians seem to have been one of the most warlike nations of antiquity, and to the extension of the Roman empire in the east they effectually set bounds. Their frequent wars with the Romans, however, proved in the end fatal to the Parthian empire, for in the time of the emperor Macrinus, having an engagement with them of two day's continuance, so great a number of them was killed, that the Persians embraced the opportunity for a revolt. Another dreadful battle ensued, which continued three days; and after this the Parthians, unable to make farther resistance, were compelled, after having maintained their independence 475 years, to become vassals to the Persians.

The restorer of the Persian empire at this time was named Artaxerxes or Artaxares. His first step was to demand of the Romans a cessation of all the provinces of Asia Minor, which he considered belonged of right to him, as having been the possession of his ancestors. An immediate war was the consequence of this, which war ultimately disabled both empires. The Saracens were consequently enabled entirely to overthrow the empire of Persia, and greatly to reduce the power of the Constantinopolitan or eastern Roman empire.

On the decline of the Saracen empire, Persia became subject to various usurpers till the time of Jenghis Khan, by whom it was conquered, and concontinued subject to his officers as a province of his empire till the year 1523, when it once more became the seat of a mighty empire under Hulaku the Mogul. The empire of Persia continued under him and his successors to be very extensive, and was united under one head till the commencement of the fourteenth century, when it was divided among a number of petty princes. But when these petty princes were reduced by Tamerlane, the Persian empire once more revived, though it continued united only under him and his son Shah Rukh. It became on the decease of Shah Rukh a prey to petty tyrants as before, till the commencement of the 16th century, when it was reduced by one Ishmael Soci, said to have been a descendant in a direct line from Ali, the son-in-law of Mahomet. By the year 1510 he had conquered the city of Bagdad, and was making great progress westward, when he received such a defeat from the Turks as effectually put a stop to his conquests on that side. Shah Abbas the Great, who ascended the throne in 1584, found the empire in a deplorable situation from the depredations of the Turks and Tartars, who had taken some of the finest provinces. Having defeated the atter, he fixed his residence at Ispahan, the capital, and then turned his arms against the Turks, whom he overcame, and recovered the dominions which had been seized by them. He next attempted to promote commerce and civilize his subjects; but all the great actions of this sovereign were sullied by his base cruelties. In 1622 he took from the Portuguese the island of Ormus, but this conqnest was effected by means of some British ships. He died in 1628. The successors of Shah Abbas were remarkable only for their vices, the consequence of which was a revolution in 1716, when Shah Husseyn, the reigning prince was dethroned by the Afghauns. The princes of this race enjoyed the sovereignty only 16 years, when Ashraff, the possessor of the throne at that time, was deposed by one of his officers. On this, Tahamasp, otherwise styled Prince Thamas, the only survivor of the family of Abbas, assembled an army, invited into his service Nadir Khan, who, on account of his valour and prudence, had acquired great reputation. He was the son of a Persian nobleman on the frontiers of Usbec Tartary; and his uncle, who was his guardian, keeping him out of the possession of his estate, he associated himself with the banditti, and robbed the caravans. His followers gradually increased to the number of 500, and Nadir became the terror of all that country, especially of his uncle. The latter, therefore, attempted to make peace with him, and for this purpose invited him to an entertainment; but Nadir caused him to be murdered, and the whole of the people to be turned out of the castle. Having thus procured his inheritance, he gradually became more powerful, and at length obtained the command of the Persian army from Prince Thamas. He soon after overcame and put to death the usurper Ashraff, and likewise his lawful sovereign Prince Thamas, and then usurped the throne under the title of Nadir Shah, or King Nadir. The other title by which he is distinguished, namely, Thamas Kouli Khan, *i. e.* the slave of Thamas, was given him before he aspired to the throne. He next laid siege to the city of Candahar. While he remained before this place, he received an invitation from one of the parties which at that time disturbed the empire of the Great Mogul. This invitation was immediately accepted, the Mogul was betrayed into the hands of the Persians, and Nadir Shah thus became master of Delhi. As the prospect of great wealth had been his principal motive in this expedition, he took the readiest means to realize his expectations; that is, he summoned all the viceroys and governors of provinces to attend him with what treasure they could procure, and that under pain of severe tortures, by which means he amassed no less than 231 millions. He then prepared for his departure, reinstating, however, the Mogul in his sovereignty, and even advising him how best to govern his empire, and prevent disasters of the like kind in time coming. He afterwards undertook an expedition against the Usbeck Tartars, in which he proved successful; but he was unfortunate in his attempt on the Tartars of Daghistan, when, through the difficulties experienced in his march, he lost the greater part of his army. He was once more successful against the Turks, defeating them in several engagements; but he was twice obliged to abandon the siege of Bagdad. Attempting at length to overthrow the established religion of the country, and behaving with such cruelty and absurdity as gave reason to suppose that his brain was affected, he was assassinated in the year 1747, by his own relations. A violent contest for the sovereignty ensued after his death, which was not ended till the year 1763, when one Kerim Khan obtained the crown of Persia, having obtained the superiority over all his competitors. He refused the title of *Shah* or *king*, being satisfied with that of *Vakeel* or regent. On his decease, in 1779, new competitors for the throne sprung up, and caused another period of slaughter till the year 1794, when Akan Mahomed Khan became sole monarch.

Though Persia seems at length in some degree to have settled into two divisions, the eastern and the western, as already noticed, the provinces near the Caspian, secured by mountains and fortresses, have asserted a kind of independence. See Sir Robert Ker Porter's *Travels in Persia, &c.*, Malte Brun's *Geography*, Vol. II. Kinnear's *Geographical Memoir of Persia*, Morier's *First and Second Journies*, Sir John Malcolm's *History of Persia*, Franklin's *Observations, &c.*

PERSIAN WHEEL, a machine of ancient invention, turned by a rivulet or other stream of water, and fitted with open boxes at its cogs. For a description of this machine and its mode of working, see MECHANICS.

PERSIAN ÆRA, or Æra of Yezdegerd, an era commencing with the eleventh year of the Hegira, viz. in June A. D. 632. See *Chronology* under HISTORY.

PERSIUS, AULUS FLACCUS, a Latin poet, was born, according to some, at Volterra, in Tuscany, and, according to others, at Teguila, in the gulph of Specia, A. D. 34. He spent the early part of his life at Volterra, and in his fifteenth year he removed to Rome, where he prosecuted his studies under Palæmon, the grammarian, Virginius, the rhetorician, and Cornutus, the celebrated Stoic. Though the satires of Persius are sharp, acrimonious, and licentious, his character as a man was unimpeachable; for he was chaste, meek, and modest,—a steady friend, a good son, an affectionate brother and parent. By his satirical humour he greatly distinguished himself, and he made the faults of the orators and poets of his age the subject of his poems. In his writings, he uniformly consulted Cornutus; and for the character and abilities of that illustrious friend he shewed his regard, by making mention of his name in his satires with great propriety. He was of a weak constitution, and died at the early age of 30 years. His books, consisting of 700 volumes, he left, together with a considerable sum of money, to Cornutus, who accepted of the books, but generously gave the money to the sisters and friends of the deceased. The works of Persius are enigmatic, in which respect they have been compared to the Greek Lycophron. His cotemporaries highly esteemed him. Lucian, who studied with him under Cornutus, was so delighted with his verses, that he was always breaking out into acclamations at the beautiful passages in his satires. Quintilian allows that he acquired a great deal of true glory. Perhaps the only difficulties which now appear to the moderns, in the six satires of Persius, arise from their not knowing the various characters which they described, the vices which they lashed, and the errors which they censured. The best edition of the works of Persius is that of Casaubron, London, 12mo. 1647.

PERSONAL ACTION, in law, is an action levied directly and solely against the person, in contradistinction to a mixed action.

PERSONIFYING, the speaking of things as if they were persons. The use of this figure is very natural and extensive; there is a wonderful proneness in human nature under emotion to animate all things. Thus, when we say "the ground *thirsts* for rain," or "the earth *swells* with plenty;" when we speak of a "disease's being *deceitful*," or of "ambition's being *restless*," such expressions shew the facility with which the mind can accommodate the properties of living creatures to inanimate things, or to abstract conceptions of its own forming. See LANGUAGE.

PERSPECTIVE, the art of delineating or representing visible objects on a plane surface, with the magnitudes, positions, proportions, distances, &c. in which they appear to an eye situate at any given fixed point. This branch of mixed mathematics, which depends jointly on optics and geometry, teaches the method of tracing the outline or skeleton of a picture, while to the art of painting belong the colouring and shading of it. See *Linear Perspective* under the article DESIGN.

PERSPECTIVE MACHINE, an instrument for delineating the true perspective appearance of any object. The description of this kind of machine is given in many of the works on perspective. See

*Edinburgh Philosophical Journal*, Vol. II. for an account of a very ingenious perspective machine invented by the late Mr James Watt,—and Ferguson's *Perspective.*

PERSPECTIVE PRISM, an instrument for illustrating the principles of perspective. Of this prism, a distinct account is given by Mr Martin, in his *Principles of Perspective*, to which we refer the reader.

PERSPIRATION. See ANATOMY.

PERTHSHIRE, a county which is the most extensive in Scotland, as well as the most remarkable for splendid scenery. Its longest diameter, between the east and west, is about 80 miles, and the shortest, from north to south, is nearly 70; the total area is estimated at 5000 square miles. This county is bounded on the west by Argyleshire, on the north by the shires of Aberdeen and Inverness, on the east by Forfarshire, on the south-east by the frith of Tay and the counties of Fife and Kinross, and on the south by the Frith of Forth, and the counties of Clackmannan, Stirling, and Dumbarton.

*Aspect.*—Though Perthshire contains many extensive tracts of flat land, or of low undulating hills, it is in every sense of the word a mountainous country. It is naturally divided into two portions, called the Highland and Lowland districts; the former being of a bold mountainous character, while the latter is agreeably interspersed with hill and vale, and displays all the beauties of cultivation. The Grampian mountains cross the country from south-west to north-east. The country north-west of this ridge is mountainous, and contains several lakes; but the opposite side is more low and fertile, and being covered with agriculture, wood, and gentlemen's seats, it presents a most interesting appearance.

*Climate, soil, &c.*—The climates of Perthshire are as various as its surface, and scarcely admit of any beneficial detail. In the higher valleys, the summer is short, and snow is of frequent occurrence in winter. The higher tracts, however, are not much exposed to inconvenience from the east wind, which is mitigated or expended in its passage over them. It is from a cloudy sky that these districts suffer most, to which is to be attributed the lateness and imperfection of their crops. The tracts most subject to rain are the several mountain glens, where the quantity is various, and cannot well be calculated. It appears that Perth is the least rainy tract, the average water of which is estimated at about 23 inches yearly. With respect to the soil and climate, Perthshire is naturally divided into the Highland district, the Lowland district, and the district of the Carse of Gowrie. These districts vary from one another very materially. The first of these, comprehending the larger portion of the county, is formed by the Grampians. In the valleys, the soil generally consists of a brown loam of uncommon fertility, lying on a sound, dry, gravelly, or sandy bottom. On the sides of the hills the same soil prevails to a considerable height. The second district includes all that portion of the county lying to the south of the Grampian mountains, with the exception of the Carse of Gowrie. The soil of the level lands along the Forth, for an extent of 18 miles, from Earthmore to the bridge of Allan, is a deep rich clay. The district called the Carse of Gowrie, situated along the northern shore of the frith of Tay, is a long narrow plain, extending sixteen miles in length, and containing about 18,000 acres of extremely rich and fertile soil.

The agriculture of this county is various and unequal. There are, however, many farms, reaching from 300 to 500 acres and upwards, the chief of which are found in the Carse of Gowrie, in Strathearn, at its lower part on the banks of the Isla, and on the banks of the Tay, principally between Perth and Dunkeld. Grain is the chief object of cultivation in Perthshire. On most of the low alluvial lands, and in some places even on the uplands, wheat is raised to advantage; and some barley is grown in the better class of lands. The culture of flax is universal among the small farmers. Potatoes are raised in great quantities on the light soils, as well as turnips. Peas and beans are not much cultivated, and the cultivation of rye is so scanty as to be scarcely deserving of notice. Artificial grasses are cultivated for hay in the lower lands, and the cultivation of clover, as well as that of turnips, has reached the Highland districts. The pasturing of cattle, in the mountain districts, is practised in various places, but it is to sheep that these tracts are chiefly allotted. The breed of ponies is considerable in the Highland districts. Few black cattle are reared, but every farmer keeps a certain number of cows. Sheep-farming is so extensive, that twenty-seven parishes are said to be almost entirely occupied with sheep. Swine are cultivated, but goats have been expelled. In this county, neither pigeons nor bees form a specific object of rural economy.

*Woods and plantations.*—In Perthshire, trees of every kind flourish naturally. The ash, especially, grows with the greatest vigour, and even on elevated grounds; but the oak and beach do not grow to a large size. The finest trees of all kinds, any where to be seen in Scotland, are produced in the vicinity of Duplin. Extensive coppices of oak occur at Dunkeld, and in various other places along the banks of the Tay and the Tumel, as well as on the skirts of the different lochs. There is only one forest in the county, namely, that of Rannoch, which occupies its southern margin, but which is now almost a ruin. The most woody regions are Strathtay, the upper and lower parts of Strathearn, part of Strathmore, Glenlyon, Strathtumel, Blair, and especially Dunkeld, to which this division of Scotland is chiefly indebted for its great superiority in general appearance to all the counties of North Britain.

In Perthshire many extensive plantations have been made, among which are the fir woods of Meikleoure, and the plantations of Scotch fir at Dunkeld and Blair, belonging to the Duke of Athole. The whole plantations that have been planted by his grace amount to 11,000 acres, the principal part of which lies in the vicinity of Dunkeld, and on the hills. Of this, the greater portion consists of larch; but much Norway spruce has been also planted within these few years. Estimating the number of plants at 2000 per acre, this amounts to about

22,000,000 of trees; but the whole number of trees, planted by the duke is about 50,000,000; the former plantations having been about from 5000 to 6000 per acre. Near Loch-Ordie the plantations are at an elevation of about 1000 or 1200 feet, at which height they promise to thrive. The larch is found to thrive in a higher region than the Scotch fir, and likewise to grow quicker, so as far to out-top it in the same plantation. The growth of the spruce is rapid and strong; and the timber, which has been employed for spars and top-masts, from some of the older trees about Blair, has been found not inferior in quality to that of Norway imported for the same purposes.

*Mountains, rivers, and lakes.*—Three lofty chains of mountains, namely, the Grampian, the Ochil, and the Sidley, or Sidlaw hills, intersect the county of Perth. Ben-Lawers, which is among the most remarkable mountains in Scotland, rises to the height of 4015 feet. Cairn-Gower, part of the ridge of Ben-Gloe, being next in elevation, is estimated at about 3700 feet. Ben-Vualach is supposed to be not much less, though inferior to Ben-Aulder in Inverness-shire, which unites with it in forming the northern extremity of Loch-Ericht. Shehallien, which is conspicuous for its beautiful conoidal outline, rises about 3400 feet high. Ben-More, a part of the southern boundary of Glen-Dochart, is more than 3000, as is also Ben-Vorlich to the south of Loch-Earn. Ben-Ledi is of somewhat less elevation; and Ben-Venu adds much to the delightful scenery of Loch-Cathrine. From the tops of these mountains the prospects are, in general, grand, extensive, and delightful; but, in particular, the view from the top of Mordun is so remarkably rich and various, that it has been styled the glory of the north.

The Tay, the Earn, and the Teith, are the principal rivers of this county. The Tay abounds in salmon, and is the pride of Scotland. On the southern bank of this truly noble river, the city of Perth is situated. It takes its rise in Breadalbane, on the frontiers of Lorne; and, in its course to the German ocean, it forms two lakes, Loch-Dochart and Loch-Tay, and terminates in an estuary equally important as the Forth. The Earn, which joins the Tay, takes its rise from a lake of the same name, near the mountain of Ben-Vorlich, and flows through a luxuriant tract of country, designated by the general appellation of Strathearn. The Teith is famous for its salmon-fishery, and its steep cataract, near the Blair of Drummond, the noise of which is remarkably loud. There are a number of subordinate streams in the county, among which are, the Almond, Ailan, Braun, Garry, Isla, and Dovan. The principal lakes are Loch-Tay, Loch-Cathrine, Loch-Earn, Loch-Dochart, Loch-Ericht, Loch-Rannoch, and Loch-Monteath.

*Game and fisheries.*—In Perthshire, the number of deer has been generally estimated at 6000; and, as the Duke of Athole and other proprietors are now preserving their deer, their numbers are supposed to be considerably on the increase. The preserve for deer, belonging to his grace, is reckoned at 80,000 acres; but it is not absolutely a preserve, as it contains a number of sheep. In Athole, moor-game, being preserved together with the deer, is very plentiful. On all the high mountains, especially in Athole and on Ben-Lawers, ptarmigans are likewise abundant, and in Strathearn pheasants are numerous.

This county is well supplied with fish from its numerous lakes and rivers. Of the value of the salmon-fisheries some idea may be formed, when it is stated, that the annual rent of the first 18 miles of the river Earn, is L.10,000, and that of the Tay is perhaps much more, independently of the more remote streams. Trout, perch, pike, and eels are plentiful, and the char is found in some of the lesser alpine lakes about Ben-Gloe.

*Mineralogy, &c.*—The rock of which the Grampians chiefly consist is granite; but on the southern ridges of these mountains, both slate and freestone are found in abundance. In some parts of Perthshire iron-stone appears, but no mines have been opened, except on the southern side of the Ochils, about Culross, which is the only coal district in the county. The best quarries for free-stone are those in the parish of Tulliallan, on the Forth, and on the estate of Milnfield, in the south-eastern corner of the county. About twenty years ago, some lead ore was discovered in the mountain of Ben-Ledi, and two lead mines, one near Tyndrum in Breadalbane, the other in Glenlyon, were formerly wrought. That peculiar species of rock called breccia, is common in the neighbourhood of Drummond Castle. The mineral waters of Pitkeathly, a village in Strathearn, in the parish of Dumbarny, about five miles south from the town of Perth, have long been famed for their efficacy in curing or alleviating the scrophula, scurvy, gravel, &c.

*Population, &c.*—In the county of Perth there are 62 parishes. The freeholders are 222; and, besides the county member, Perth returns one, together with Forfar, Dundee, Cupar, and St Andrews. The total population of Perthshire, in 1811, was 135,093, but in 1821 it was found to have increased to 139,050.

*Manufactures.*—Linens and cottons of various kinds, together with shoes, of which the seat is at Perth, constitute the principal manufactures of this county. The chief linens are ordinary brown and white, and some diaper is also made. The cottons are ordinary plain and printed shawls, handkerchiefs, and muslins. The printfields are at Cromwell-haugh, Hunting-tower, Stormont-field, and Tulloch; and the principal bleaching-grounds are at Luncarty, Hunting-tower, Stormont-field, Lawton, Kier, and Crieff. Sail-cloth and osnaburgs are made at Alyth; coarse woollens, as well as cottons, are wove at Dunblane; and cotton-weaving and tambouring are carried on to a small extent at Callender. Tambouring is also established at Crieff, Culross, and Kincardine. At Crieff and Thornhill, much leather is dressed; and in different parts of the county paper mills and oil mills have been established.

Perthshire carries on a considerable trade in sheep and black cattle, as well as wool. The other articles of commerce are grain, bark, and timber. Salmon forms a branch of internal commerce as well as of exportation. It is exported chiefly to London, both fresh and pickled. Of the internal trade of Perthshire, one of the principal branches is carried on at Kincardine and Culross, where above seventy vessels of small tonnage are employed in carrying coals to the Baltic and elsewhere, in return for which they bring back corn, timber, and other articles. The town of Perth is the chief port, whence are exported grain and manufactured goods, and which imports coal, lime, and numerous articles essential for the ordinary consumption of a country. Vessels are also built at Perth, and chiefly from native timber.

*Towns and villages.*—The town next in importance to Perth in this county is *Crieff*, with a population estimated at about 3000. *Callender* is perhaps the next in order, and it is also a chief point of communication with the Highlands. *Doune* was once the great Highland mart, and celebrated for its manufactory of pistols; but it has declined. *Comrie* is rising in respectability, and is conspicuous for its neatness. On account of its mineral waters, *Dunblane* has recently become a resort of summer visitors. *Auchterarder* is the seat of a linen and woollen manufacture. *Blairgowrie* is likewise a seat of the linen manufacture, and is in a somewhat prosperous condition. *Cupar*, though not remarkable for neatness, is of considerable size; it is situated in Perth rather than in Angus. *Culross* approaches nearly to Fife, under which we have noticed it. (See FIFE.) *Dunkeld* is the chief market town of the Highlands, and carries on a manufacture of linen and yarn. Owing to the building of the bridge, it has lately undergone some improvements. *Alyth* towards the coast, and *Abernethy* on the confines of Fife, are rather villages than towns. *Aberfeldie* is a village of some size, and a convenient centre for a fertile and populous tract that surrounds it. The villages of Muthill, Methven, Errol, Kenmore, Killin, Moulin, Blair, Aberfoyle, do not merit any particular notice.

*Antiquities.*—Some druidical circles are found in different places, more or less perfect, and one of the most remarkable lies in Strath-Tay. The rocking-stone in Kirkmichael is a natural curiosity. Of ecclesiastical antiquities Perthshire possesses its share in the cathedrals of Dunkeld and Dunblane, both of which are interesting ruins. The tower of Abernethy, similar to that of Brechin, has long been a problem with antiquaries; nor has any natural theory been advanced concerning it. At Culross are the remains of a Cistertian abbey, founded in 1217 by Malcolm earl of Fife.

Perthshire was the scene of many conflicts fought in support of the last gleam of Caledonian independence in the Lowlands. The precise spot where the heroic Galgacus was overcome by Agricola is not known; but it is conjectured to have been in Stormont, where a large Roman encampment is still visible, together with a number of cairns. There is another encampment at Ardoch, which is perhaps the most perfect specimen of the kind in Great Britain, and near it are two smaller ones less perfect in their construction. At Ochil there is likewise a Roman encampment, which communicates with Ardoch by a raised road or causeway.

*Perth*, the capital of the above county, is finely situated on the banks of the river Tay, about 20 miles from its mouth. Its environs present an interesting aspect. The entrance to Perth from the Edinburgh road, is on a gradual descent to the South Inch, and is beautifully picturesque. At the commencement of the Inch (a spacious green) there is a grand avenue of trees which extend to the town on the north side, on which there is another inch or green equally delightful. These fine expanded lawns are adorned by the river Tay, which flows along their green banks, the opposite shore being clothed in all the luxuriance that art and the hand of cultivation can produce. Adjoining the North Inch is a handsome bridge which crosses the Tay; and immediately across this bridge is situated the village of Bridge-end leading to Kinnoul Hill, whose summit at the distance of a mile and a half can be agreeably ascended by Montague Walk, winding through a wood about one half of the distance. The precipice of Kinnoul is more than 600 feet perpendicular, and presents one of the most delightful prospects imaginable. The noble river which flows along the base of this stupendous height, the hills and more immediate objects in the fore-ground, and the grandeur of the mountainous perspective, afford a scene scarcely to be equalled. On the eastern bank of the river stands Scone Palace, a magnificent pile of building, surrounded by extensive pleasure-grounds. This celebrated structure has been recently re-erected. The chapel, also newly built, is at a short distance from the palace, and is surrounded with majestic trees, which add to it an air of pleasing solemnity. To form a just idea of the beauties with which the vicinity of Perth abounds, they require to be visited.

The town of Perth is large and well built; the two principal streets are long and spacious, and kept remarkably clean, well paved and lighted. It appears to have once assumed the name of St John. At the early period when the Scots king succeeded to the Pictish throne, the church and bridge of Perth were supposed to have been consecrated to St John the Baptist as the tutelary saint of the town, and hence it gradually obtained the name of St John's town; but it does not appear to be fully known whether it was ever recognised by that name in any of the public writs of that period; the origin of its name may however be very plausibly conjectured from Fordun's *History*, wherein he remarks that he had found in some ancient writs that the town of St John, now called Perth, was anciently called Bertha; and the contracted name of Bertha being Berth or Bert, and as the letters *b* and *p* are in the Gaelic language used indiscriminately, it may therefore be naturally presumed that the Highlanders might have changed the pronunciation of it to Perth, from which circumstance very probably the present name of the town is derived. The Highlanders at this period pronounce the word Perth, *Peirt*, or *Peart*. The new town of Perth, which was begun in 1798, contains a beautiful circus and a terrace. The town-house, which forms the eastern termination of the High Street, is a spacious structure, as is likewise the guild-hall. The parish church, which is famous as the place where John Knox first preached the Reformation, is a large and ancient edifice, at present separated into three divisions, named the east, middle, and west kirks. There is another parish church dedicated to St Paul, a chapel of ease, and various meeting-houses belonging to the dissenters. The chief public institutions in this town are a grammar-school, an academy, and a literary and antiquarian society. A little to the south of the bridge, in a line with the river, the new prison and county buildings are erected; the principal front is very elegant, and embellished in the centre by a fine portico supported by twelve massy columns; the front is of freestone, and the edifice has a beautiful effect when viewed from the opposite side of the river. This building contains the court of Justiciary, which is of a circular form; the gallery is very judiciously constructed, and is capable of holding 1000 people. The various apartments for the affairs of the court on the ground-floor are spacious and handsome, and the repositories for the records of the town are finished in a superior style of security; above is an extensive ball room, with an elegant card-room adjoining; over this suite of rooms is a spacious supper-room, the ceiling of which is supported by elegant fluted pillars. The county buildings are said to be an exact copy of a temple at Pæstum in Italy. Few traces now remain of the ancient importance of Perth while it was a royal residence. The original fortress belonging to the town is now a ruin, and of the monastic institutions the sites are not even discoverable to the eye. Gowrie castle, the residence of the earls of Gowrie, is situate on the south-east side of the town. This castle became the property of the corporation after the forfeiture of the Gowrie estates, and was presented in 1748 by the magistrates, together with the freedom of the burgh, to William Duke of Cumberland, who afterwards sold it to the Board of Orddance for the sum of L.5000, and it has ever since been appropriated as barracks for a company of the Royal Artillery.

The population of Perth in 1821 was estimated at 19,068. The flourishing state of this town arises in a great measure from the constant intercourse maintained with London by water. Merchant-vessels also frequent this port, and those of heavier burden are loaded or discharged in the river by means of hoys. Linen is the staple manufacture, but the cotton trade is rapidly on the increase. Cotton-mills, bleach-fields, and print-fields, have been established. Leather is also one of the manufactured products of Perth; and in the town the manufacture of doe-skins and buck-skins has long been carried on. Perth is a royal burgh, and joins with Dundee, Forfar, Cupar-Fife, and St Andrew's, in sending a member to Parliament. It is governed by a provost, who exercises the offices of sheriff and coroner within the town, three bailies, a dean of guild, treasurer, and town-council.

In Perth the funds for the poor are considerable. A thousand pounds per annum are raised by assessment on the town and landward part of the parish; about L.700 are raised by collections at the established churches, each of the incorporated trades supporting their own poor from their funds. The property belonging to the religious houses in Perth at the time of the Reformation was consolidated by King James, and erected by charter into a new institution designated *King James's Hospital of Perth* for poor members of Jesus Christ. In 1823 the funds of this institution were about L.6000, which funds are under the management of the ministers and elders, and arise out of the property belonging to the charter-house, feus, ground-annuals, &c.: The ground-annuals arise out of certain bequests to the religious houses with which individuals burdened their property. Thus, one person left a stone of wax, another a number of pounds of wax candles, to be consumed at the altar of some favourite saint on some particular occasion. There were also left to the poor of Perth nine-tenths of the farm of Lethindy in the parish of Scone: at present this farm is let at the yearly rent of L.1100, five-tenths of which are given to the poor, chiefly to such as have been reduced from respectable circumstances, at the rate of L.30 per annum; but by the will of the bequeather the remainder is under particular restrictions.

PERU, a Spanish province in South America, which extends about 420 geographical miles from the river Tumbez on the north to the desert of Atacama on the south, its medium breadth being about 80 leagues. It was formerly the richest and most extensive kingdom in South America; but in 1718 it was disjoined from Quito, and in 1778 from Potosi and some other provinces on its southern frontier, which were annexed to the vice-royalty of Rio Plata.

The square contents of Peru are estimated at 33,628½ square leagues, and the population at 1,400,000. The number of districts is 49, and of townships 1360.

*Mountains.*—Two chains of mountains traverse Peru, from north to south, in directions nearly parallel. One is the great central chain of South America, or the Cordillera of the Andes; and the other, which is considerably lower, is named the Cordillera of the coast. The summits of the more inland mountains are perpetually covered with snow; and that volcanoes have formerly existed in some of them, seems more than probable. The mountains toward the coast contain mines of gold, silver, copper, and tin, and are partially covered with forests.

The *climate* of this country varies according both to the latitude and elevation of the various districts. A division into three parts, namely, the maritime plains or valleys, the mountains themselves, and the high table land, or upland plain, between the ridges of the Andes, is occasioned by the mountains that are extended on the western side of South America. Rain is almost unknown in the lower part of Peru; but, throughout this region, vegetation is supported by a liberal dew. In the high table land called the Sierra, the heat of summer prevails in the valleys, while the most piercing cold is felt in the mountains. The variations of temperature are not very considerable in the vicinity of Lima, in which district no rain falls, but the dews are heavy and regular. Earthquakes are frequent along the whole coast, but thunder and lightning are of such rare occurrence that those of the inhabitants of Lima who have not travelled into other parts of the country are very much terrified at these phenomena when in other countries. The spring begins towards the close of the year—the summer is tempered by southerly winds—the autumn is of short continuance,—and the winter begins about the latter end of June with cloudy weather.

*Soil and productions.*—There is but little fertile land in Peru, which cannot become wealthy by its agricultural produce, especially as all exertions for the improvement of agriculture are impeded owing to the want of roads for conveying the produce of the country to a market. For the cultivation of cotton and sugar, the soil and climate are well adapted. The vicinity of the coast produces many of the tropical plants and vegetables, such as the cabbage-palm, the cocoa-nut, the chocolate-nut, the cotton-shrub, the pine-apple, the canna, amomum turmeric, plaintain, and sugar-cane; and more hardy plants are found in the more temperate climate of the high plains. Around the neighbourhood of Lima, the large flowered jessamine and datura arborea diffuse their fragrance. No fewer than twenty-four species of pepper, and five or six of capsicum, are reckoned by the Peruvian natives; and in the groves at the foot of the Andes, tobacco and jalap are very abundant. In Peru there are no carts or waggons for the conveyance of goods; and no other means of transporting them but on the backs of mules, which, for want of roads, are driven through the fields. From this cause, one district may be overflowing with plenty, for which no vent can be found, while another may be suffering all the extremity of want.

*Rivers.*—The chief rivers in Peru originating in the Andes, flow eastward to the Atlantic ocean; and several small rivers empty themselves into the Pacific ocean, between the equator and eight degrees of south latitude. The lake of Titicea, in the valley of Callao, is more than 70 leagues in circumference; and, besides this lake, there are several others of great extent in Peru.

*Natural history.*—The river Guyaquil abounds with alligators; and the neighbouring country swarms almost as much with snakes and vipers as that round Porto-Bello does with toads. Peru has not many wild beasts, and those that inhabit it are not very dangerous. Of these, the fiercest are the puma and jaguar, inaccurately called lions and tigers by the Europeans, but which possess neither the undaunted courage of the former, nor the ravenous cruelty of the latter. A quadruped called the lama, peculiar to this country, bears some resemblance in form to the camel, and is about the size of a stag; its wool furnishes the Peruvians with clothing, and its flesh with food. The lama can endure amazing fatigue, and will travel over the steepest mountains with a burden of 60 or 70 pounds. The cattle imported from Europe are much increased, and the greater part of them run wild, and are hunted like other game. The condor, which is said to be capable of carrying off sheep and even young heifers, is among the most remarkable of the birds of Peru. The bird called the toucan is remarkable for having a bill as large as its body; and though mute as a fish, it is called the preacher by the Spaniards. There is a sea-fowl, with feathers on the body, while the bare wings resemble those of the bat. Several insects like those of Europe are found here, but they are much larger. In Peru the bats are of amazing size; are very destructive to cattle, and will suck the blood of horses, mules, and even of men while asleep in the fields.

*Mines.*—Peru is principally noted for its mines of gold, silver, and quicksilver, which are the chief source of its riches. There were wrought in this country, about the end of last century, four mines of quicksilver, four of copper, 12 of lead, 70 of gold, and 784 of silver. Of these mines, the produce for 10 years was 34,152,189 dollars. Peru produces a great variety of other minerals, such as basalt, the stone of the incas, which is a compact marcasite capable of a high polish, the piedra del gulinazo, or obsidian, rock salt, and stones of various colours. Platina, which, from its superior qualities, may almost vie with gold itself, is likewise found in Peru.

The *manufactures* of this country are of no great extent. At Cusco, and in its territory, are made stockings, handkerchiefs, and scarfs; and the wool of the vicuna, mixed with that of the sheep imported thither from Europe, serves for carpets, and for making a tolerably fine cloth. Fleeces of inferior quality are employed in serges, druggets, and in all kinds of coarse stuffs. At Arequipa, Cusco, and Lima, are established the manufactures subservient to luxury.

The *commerce* of Peru is divided into three branches, viz. its commerce by land with the provinces of the Rio Plata, its commerce by sea with the other colonies, and its commerce with the mother country. The principal trade of Peru, since the freedom of commerce in 1778, has been carried on by Cape-Horn. In general, the exports are gold, silver, wine, brandy, sugar, pimento, Jesuit's bark, salt, vicuna, wool, and coarse woollens; in return for which are imported European goods, live stock, provisions, tallow, Paraguay tea, indigo, timber, cordage, pitch, and copper. The luxury of dress being the prevailing passion in Peru, superfine cloths, silks, and fine linens, are important articles of importation. Some considerable trade is carried on between Lima and various parts of the Pacific. The trade of Peru with Spain consists in the exportation of gold, silver, Jesuit's bark, and vicuna wool. This trade has been made free, since the year 1783, between certain ports in Spain and others in the South sea, without being subject, as formerly, to restrictions and licences.

*Government.*—As the country is partly in the hands of the patriots or independents, and partly in the possession of the armies of the royalists, the government of Peru is, by no means, in a settled state. In the general state of Peru, and the adjoining countries, many important changes may be supposed to be produced by the late revolution in the Spanish provinces of South America; but of the progress of this revolution, too little is known to admit of any satisfactory details. The nett annual revenue of Peru, after remitting 300,000 dollars to Panama, 15,000 to the island of Chiloe, and a third sum to Valdivia, and defraying the expence of the government, is supposed to amount to 500,000 dollars.

*Natives.*—Peru is inhabited by European Spaniards, Spanish Creoles, native Indians, mestizoes, negroes, mulattoes, and Samboes. The character and situation of these castes are pretty similar to those of Mexico. The Peruvians go naked, and paint their body with a red drug called rocu. In general, the free mulattoes are tradesmen, and carry on most of the mechanical professions. One man will build his own hut, construct his own canoe, and weave his own cloth; and when a large house is to be built for common use, a number of individuals co-operate together. The natives who live in Quito are of a different temper, being remarkable only for idleness and stupidity. The mulattoes who resemble the Spanish gypsies in complexion and manners, are commonly employed as servants, and the women as wet-nurses to the children of the Creole ladies. The Creoles are proud and fond of parade, but humane and kindly in their dispositions: some of them have titles of nobility, and possess considerable estates; notwithstanding which, they are excluded from all offices of trust and honour. The Peruvian Indians, as well as the Creoles, are remarkably long lived. The Indians wear a dress consisting of white cotton drawers, which hang down to the calf of the leg, and are edged with lace; a black cotton frock, made in the form of a sack, with three openings at the top, one in the middle for the head, and others at the corners for the arms, a serge cloak, having a hole in the middle for putting the head through, and a hat made by the natives. Though they wear no stockings, they are fond of silver or gold buckles to their shoes. The Indian women wear two kinds of dresses, consisting of a shirt, petticoat, and a veil of American baize. The dress of the lowest class of Indian women is only a bag similar to that of the men, which they fasten on their shoulders with two large pins, and which reaches down to the calf of the leg, and is fastened round the waist with a kind of girdle; they wear about the neck a piece of the same coarse stuff dyed black. The number of Indians in South America has greatly diminished since the conquest; and as the other castes have not increased in a degree corresponding to this diminution, the whole population of the country is less than when first discovered by the Spaniards. Many causes have contributed to thin so dreadfully the number of the Indians, among which the abuse of spirituous liquors is the principal.

The favourite liquor of the natives of Peru is brandy, and rum is commonly used by persons of all ranks. A liquor called *ovate*, which is made of an herb known by the name of Paraguay, as being the produce of that country, is much used in Peru.

The grammar of the Peruvian language, and it is said even that of the Tehuels, is nearly as variegated and artificial as the Greek,—whence our wonder at the refinement of the Sanscrit may be considerably abated.

How far the power of habit is capable of prevailing over reason and prudence, is strikingly exemplified in the extravagant manner of performing the last office for the dead in Peru, where the people may be said to toil and scheme to lay up wealth to enable their successors to lavish honours upon their dead bodies. Indeed, many families of credit have been ruined by preposterously endeavouring to excel others in this absurd practice.

*History.*—Before its subjugation by the Spaniards, Peru was a powerful empire, extending about 600 leagues along the coast of the Pacific ocean. In 1512, this country was discovered by the Spaniards. Nunez de Balboa having been made governor of a small colony at Santa Maria, in Darien, by the suffrages of his companions, employed his utmost endeavours to recommend himself to the court of Spain, in order to have that authority confirmed; and hearing from some of the natives that there was to the south a country where gold was abundant, he determined to attempt its subjugation. Accordingly, he, with much trouble, collected a force which he deemed sufficient for the accomplishment of his purpose, with whom he set out; but the difficulties he had to encounter were extreme. He had with him in this arduous undertaking only 190 Spaniards, but they were hardy veterans, inured to the climate of America; and they bore everything with invincible patience, in expectation of a great reward. After encountering innumerable hardships, Balboa arrived at the South sea; when with transports of joy he walked into it up to the middle, and took possession of the ocean in the name of the king of Spain, swearing to defend it against all his enemies. Here he received a particular account of the empire of Peru; but, judging it improper to make any attempt with his slender force, he returned to Santa Maria, where he had the mortification to find himself superseded in the commund of the expedition, which was given to one Pedrarius D'Avila, who had brought with him 15 ships and 1200 troops for the purpose. Balboa submitted to the king's pleasure, and Pedrarius behaved in such a manner as soon convinced his majesty that he had erred in depriving Balboa of the command. He therefore appointed him lieutenant-governor of all the newly discovered countries on the South sea, commanding Pedrarius to consult with him upon all occasions. The latter, however, was so far from complying with the command of his sovereign, that, under pretence of disloyalty, he caused Balboa be condemned and executed. The death of Balboa for some time put an end to all thoughts of the conquest of Peru; and the scheme was looked upon as visionary. At last it was undertaken in 1524, by three adventurers, named Francisco Pizarro, Diego Almagro, and Hernando Luque. Of these, Pizarro, as being the least wealthy, offered to take upon himself most of the trouble and danger; Almagro was to furnish the supplies of men and provisions; and Luque, who was an ecclesiastic, was to remain at Panama, in order to negociate with the governor of that place, and to superintend the affairs of the whole armament. In consequence of this agreement, Pizarro set out from Panama with a single ship, and 112 men; but his hardships in this voyage, and afterwards, were so great, that, when advanced to the confines of Peru, his men were so very much disheartened, that only 13 of them could be prevailed to remain with him. With these he fixed his residence on the island of Gorgona, at some distance from the shore, where he was soon after reinforced by a few adventurers whom Almagro had prevailed on the governor of Panama to send to his relief. With this slender reinforcement he determined to go on with his scheme at all events; and therefore visited several places of the Peruvian empire, bringing away with him some vessels of gold, two of the Peruvian lamas, and two young men, whom he proposed to instruct in the Spanish language. The empire of Peru was at that time involved in a civil war, and Pizarro, on his return, did not fail to take advantage of this circumstance. Having received ambassadors from Huascar and Atabalipa, the two competitors for the throne, of which, indeed, Atabalipa was in the possession, he shewed himself a traitor to both. Amusing Atabalipa with the usual pretence of his countrymen, that he was ambassador from a powerful monarch, and brought him news of the utmost importance, he seized him in the most cruel and treacherous manner, making, at the same time, a most terrible slaughter among his unarmed and unsuspecting followers. Four thousand of the unhappy Peruvians perished upon this occasion; and as Atabalipa himself had come on a solemn visit to Pizarro, attended by vast numbers of his nobles, all adorned with gold and precious stones, the plunder obtained was immense. Still the covetous disposition of the Spaniards was not satisfied, which Atabalipa perceiving, determined to offer such a ransom as he thought must satisfy the utmost rapacity that could be imagined, and undoubtedly induce them to give him his liberty. The proposal he made was to fill a room, 22 feet long and 16 broad, with vessels of gold as high as he could reach; on condition that he should obtain his liberty. This proposal astonished even the Spaniards themselves, notwithstanding all that they knew of the riches of the country; yet though it was performed by the Peruvian monarch, the merciless Spaniard, instead of setting him at liberty, put him to death. This produced a general revolt of the Peruvians; but fresh supplies of Spaniards now arriving, they were obliged to yield. A dreadful insurrection took place, however, in 1536, in which not fewer than 200,000 Peruvians appeared in arms; yet, notwithstanding their utmost efforts, the valour and discipline of the Spaniards still prevailed, and the miserable Peruvians were reduced to the most abject slavery.

This empire was no sooner conquered, than the conquerors began to quarrel with one another. Almagro invaded Chili, but was prevented by Pizarro, who pretended that that country belonged of right to him. The quarrel did not end but by a civil war, in which Almagro was defeated, taken prisoner, and put to death by Pizarro; who thus remained undisputed master of the Peruvian empire. The ambition of the Spaniards, however, was not satisfied. Gonzales Pizarro, the brother of the general, was sent to discover the country to the eastward of the Andes. Immense difficulties occurred in his passage through the defiles, and over some of the ridges of these tremendous mountains; and these being got over, they descended into a flat country, where it rained incessantly for two months, without as long an interval as was sufficient to dry their clothes. Having at length got to the banks of the river Napo, one of the largest branches of the Maragnon, or river of the Amazons, they built a bark, which being manned with 50 soldiers, under the command of Francis Orellana, was ordered to wait for the rest at the confluence of the Napo with the Maragnon. But instead of this, Orellana sailed down the Maragnon itself, leaving Gonzales and his companions to their fate; and, after a most tedious navigation, arrived at the ocean, over which he sailed in his crazy bark to a Spanish settlement in the island of Cubagna, and from thence to Spain, where he gave an exaggerated account of his discoveries.

Gonzales Pizarro, with his men, arrived, in the mean time, after immense labour, at the confluence of the two rivers; but, finding no appearance of Orellana there, they proceeded 150 miles farther down the river, in hopes of meeting with him. But they only found one of his officers, whom Orellana had cruelly set on shore to perish on that desart coast because he remonstrated against his perfidy in leaving his commander. The intelligence he gave them struck the boldest with terror; as they had now to travel more than 1200 miles through the most inhospitable country before they could reach Quito, the nearest place from whence they could expect any relief. In this dreadful journey, they were necessitated to eat all their dogs and horses, to feed on the vilest reptiles, and even to devour the leather of their saddles and sword-belts. Of the whole company only 80 got safe to Quito. On their arrival, they found themselves involved in difficulties still greater than those they had experienced. An insurrection had taken place in which the general was killed, and a strong party continued in arms under young Almagro; but he was defeated, taken prisoner, and executed by Vaco di Castro, whom the king had sent over to quell the disturbances. After having defeated Nunez Vela who had been appointed viceroy of Peru, Gonzales himself shared the same fate. His opponent was named Pedro di la Gasca, whom the king had finally sent over to bring matters to some kind of settlement. Indeed, Gonzales might have rendered himself independent after the defeat of the viceroy; but his improper behaviour alienated the minds of the people from him to such a degree, that on the first appearance of La Gasca, they, with one consent, determined to submit to him. Having no resource but in his own valour and military skill, Gonzales resolved to try the event of a battle. No sooner was the engagement begun, however, than his forces almost all abandoned him, and he was therefore necessitated to decide the contest by himself with a very few of his officers and troops, who to the last continued faithful to his cause. Gonzales, when he perceived that all was lost, surrendered himself to the enemy, and was executed not long after. In the year 1550, Gasca having accomplished every object of his mission, committed the government of Peru to the court of Audience, and set out for Spain, where he was happily received. After his departure, the tranquillity of Peru was of short continuance. Several successive insurrections continued for some years to desolate the country. After the commotions had subsided, men less enterprising than the first invaders, settled in Peru, and the royal authority was gradually established as firmly there as in the other Spanish colonies. From this period the tranquillity of the country continued with little interruption till the other colonies of South America revolted, and in these revolutions the inhabitants of Peru were by no means the foremost. After several battles, attended with various success, the army of the Independents, consisting principally of Chilean troops, under the command of General San Martin, made rapid advances towards the capital. The naval achievements of the patriots, however, conduced still more to their success than their military exertions. Under the command of Lord Cochran, the Chilean fleet, after capturing several Spanish men of war, made an attack upon Calao, which attack Lord Cochran conducted in person with complete success. The Independents have since that period sustained some reverses of fortune; but Peru following the example of the other Spanish colonies, will in all probability ultimately establish its independence.

PERUGIANO, a city of Italy, in the states of the church. It is situated near the Tiber, on the summit of a mountain, and commands a delightful prospect over a considerable extent of fertile country, marked by hill and dale, and enlivened by towns and villages. The town is well built, though it has a general air of dulness. There are here some manufactures of velvet and silk stuffs, and some trade is carried on in cattle, wool, silk, corn, oil, and brandy. The population is about 106,009.

PERUKE, PERRUKE, or PERIWIG, denoted in ancient times a long head of hair; such especially of which care was taken to adjust and trim it properly; but the term is now used for a set of false hair curled, buckled, and sewed together on a frame or comb, anciently named capillamentum or false peruke. Whether the use of perukes of this kind was known among the ancients, is not certainly known. They undoubtedly used false hair, but this seems to have had scarcely any thing in common with the peruke of modern times, the use of which, at least in the present mode, is not much older than 160 years. Long perukes began to appear in Paris in the year 1629, and they afterwards spread gradually through different parts of Europe.

PERUVIAN BARK. See MATERIA MEDICA.

PESARO, a maritime town of Italy, in the territory of the pope, and duchy of Urbino. It is seated on an eminence at the mouth of the river Fogha, on the gulph of Venice, 15 miles north-east of Urbino. Pesaro is a considerable place, the streets of which are well paved with brick; and its environs are remarkable for providing excellent olives and figs, of which large quantities are sent to Venice. The castle of Pesaro is well fortified, the harbour is excellent, and the cathedral church magnificent. After this place had been taken and ruined by Totila, king of the Goths, it was rebuilt by Belisarius, general to the emperor Justinian. It became successively subject to the dominion of the Malatesta, Sforza, and Borgia families, ultimately of the popes.

PESCARA, a fortified town in the kingdom of Naples, and in the Abruzzo Cittra. It is seated at the mouth of a river of the same name, which falls into the gulph of Venice.

PEST, a town of Hungary, seated on the river Danube, in a fine plain opposite Buda, 80 miles south-east of Presburg. It is the capital of a county of the same name, and contains a fortress, a royal palace, and a university. There are in Pest many Greek merchants, who conduct the Levant trade to Germany and the northern nations.

PESTILENCE. See PLAGUE.

PETALISM, a particular method of determining on the guilt of citizens, which was introduced in Syracuse, with the view of curbing the tyranny of the richer citizens, about A. C. 460. It was so called from the Greek word signifying a leaf, because the Syracusans, to humble the aspiring minds of the wealthy citizens, who often aimed at the diadem, wrote on leaves the names of such individuals as they apprehended powerful enough to usurp the reins of government, and who, without any farther enquiry, were banished for the period of five years. This mode of punishment was similar to the ostracism of the Athenians. See OSTRACISM.

PETARD, a kind of ordnance, in form of a truncated cone, made of copper mixed with a little brass, or of lead with tin. The petard, which is very short, narrow at the breech, and wide at the muzzle, was in former times employed in the military art to break down gates, barricades, draw-bridges. &c. It is said to have been invented by the French Huguenots in the year 1579. See WAR.

PE-TCHELEE, a province of China, of which Pekin is the capital. See CHINA.

PETER, SIMON, the Apostle, was born at Bethsaida, upon the banks of the sea of Galilee, where he originally followed the profession of a fisherman. His sirname, Cephas, or Petrus, Peter, denotes a stone or rock. The peculiar features of Peter's character are very minutely portrayed in the sacred volume; but of his travels we have no where any very distinct account. Peter was a witness to our Lord's transfiguration on the Mount; he was present at the Last Supper, and in the garden when the soldiers came to seize Jesus, at which time, being transported with zeal, he drew his sword, and cut off the ear of the servant of the high priest. Peter afterwards denied that he knew his Lord, and persisted in it three times, till the cock crowing reminded him that Jesus had foretold this instance of his weakness, on which by his tears he shewed his repentance. This apostle was a witness of Christ's resurrection, and of the descent of the Holy Ghost. He afterwards zealously preached the gospel, converted 3000 persons at his first sermon, and in proof of his divine mission performed many remarkable miracles. Herod Agrippa caused him be imprisoned at Jerusalem; but he was delivered by an angel, and was afterwards opposed by St Paul at Antioch, for encouraging the Gentiles to live as do the Jews, and suffered martyrdom, being according to some killed in prison, and according to others crucified with his head downwards. Peter wrote two epistles, addressed to the dispersed Jews scattered throughout Asia.

PETER III. king of Arragon, succeeded his father James I. in 1276. Having married the daughter of Mainfroy, king of Sicily, he resolved to make himself master of that island, and to effect his purpose contrived the horrid massacre of the Sicilian vespers, or the murder of all the French in the island at the hour of vespers, on Easter-day, in the year 1282; for which crime Pope Martin IV. excommunicated Peter and the Sicilians, and laid Arragon under an interdict. Peter died in the year 1285.

PETER the Cruel, king of Castile, succeeded his father Alphonsus XI. in the year 1350, in the sixteenth year of his age. At the commencement of his reign he was guilty of several wanton acts of barbarity. Having married the daughter of Philip, duke of Bourbon, he repudiated her three days after, and sent her to prison, in order that he might be enabled to renew his connexion with his former mistress Maria de Padilla. The cruelties of this prince induced his subjects to take up arms against him in 1366, and they placed at their head Henry of Transtamare, his natural brother, who slew Philip in battle in the year 1369.

PETER the Hermit, a French officer of Amiens, who, quitting the military profession, commenced hermit and pilgrim. He travelled to the Holy Land about the year 1093, and afterwards made a melancholy recital to Pope Urban II., of the deplorable situation of a few Christians in that country, and at the same time lamented enthusiastically that infidels should be in possession of the famous city where the author of Christianity first promulgated his sacred doctrines. In consequence of this, Urban gave him a fatal commission to excite all Christian princes to a general war against the Turks and Saracens, possessors of the Holy Land. See Crusades.

PETER the Great, Czar of Russia, was the third son of the czar Alexis Michaelovitch, and was born in the year 1672. In his tenth year he was proclaimed czar in preference to his elder brother Iwan, who was by no means a fit person to manage the reins of government, being weakly in understanding, and of a sickly constitution. Peter civilized Russia, and raised it from ignorance and barbarism to a comparative degree of politeness, knowledge, and power. To give in this place a satisfactory detail of the history of his life, would far exceed the limits to which we are necessarily prescribed. The most striking passages of it are his travels, studies, and personal fatigues for the attaining of knowledge in civil and military affairs, and the improvement of his subjects; his introduction of arts and sciences, a naval force, and commerce with foreign nations; his many reformations in church and state, the army, and the manners and customs of the Russian people; his wars with the Swedes, Turks, Tartars, and Persians; victories by sea and land, acquisitions of territory, and increase of power; his regard to genius and merit, and his severe justice on offenders against the laws. All these very justly entitle him to the appellation he obtained of *Father of his country*. He died January 28, 1725. Peter was tall of stature, and of a commanding aspect. Such was his temper, that he was never known to retract a sentence once passed, and he often executed it with his own hand. For a further account of this monarch, see Russia.

PETER, commonly called the Wild Boy, was found in the woods near Hameln, in Hanover, the year 1725, at which period he was supposed to be about twelve years of age. He had for a considerable time subsisted in these woods upon the bark of trees, leaves, berries, and the like. By order of Queen Caroline he was brought to England, and placed under the care of a farmer at North Church in Hertfordshire, where he lived on a stipend of L.35 per annum allowed by government. Notwithstanding his having lived so long in a savage state, and his being quite an idiot, he was harmless and tractable. He could never be brought to speak, and died in 1785 at the supposed age of 72. He had no appearance of an idiot, nor anything particular in his form. He seemed much delighted with music, and could be taught to hum a tune. Lord Monboddo describes him as an example of his favourite hypothesis, that "man in a state of nature is a mere animal."

PETER-PENCE, was an yearly tribute paid to the pope of one penny on each house throughout England. At first this tribute was given as a pension or alms by Ina king of the West Saxons, in the year 727, he being then in pilgrimage at Rome. It was not designed, however, as a tribute to the pope, but principally for the maintenance of the English college at Rome; but the popes shared it with the college, and were careful to have it at length appropriated to themselves. The payment of Peter-pence, which tribute was so called from its being collected on the day of St Peter, *ad vincula*, was first forbidden by Edward III., but it was afterwards re-allowed and continued till prohibited by Henry VIII. Under Philip and Mary it was revived, but it was at length abolished by Queen Elizabeth.

PETERBOROUGH, a city of Northamptonshire, situated on the banks of the river Nen, over which there is a bridge. The streets are poor and the houses mean, but there is a handsome market-house and a hall for assizes and sessions. Peterborough has only one parish church, said to have been built about the year 1400. The air of this city is said not to be very wholesome, owing to the number of fens in the neighbourhood. Though it was not made a city till the reign of King Henry VIII., yet this place was distinguished in the Anglo-Saxon annals at a very remote period for its monastery, which was dedicated to St Peter at an assembly of nobles and bishops, and endowed with large immunities and possessions. In 1821, the population was 4598.

PETERHEAD, a neat and well built town in the county of Aberdeen. It is situate on the most easterly point of Scotland, being within 300 miles of the Naze of Norway. It contains several handsome houses for the accommodation of strangers, and also a ball-room, under which there are two salt water baths. The houses are elegant, and the streets spacious and very clean: and the place in short has a remarkably thriving appearance. A considerable trade is carried on from Peterhead to the Baltic. The harbour is of great importance to navigation, as it lies on a spacious bay, where vessels of any burden may ride in almost all winds. There is a mineral well at Peterhead, the virtues of which have been long celebrated as a remedy for various diseases.

PETERSBURG, or St Petersburgh, an extensive and splendid city, and the modern metropolis of the empire of Russia, situated in the province of Ingria, in north latitude 59° 26′, and east longitude 30° 25′; is built partly on some islands formed by the river Neva, and partly on the continent. It is divided into ten districts, each containing several quarters; and is about six English miles in length, and as many in breadth. The space between the left bank of the Neva and the river Moika, is denominated the first Admiralty-quarter; between the Moika and the Katarina canal, the second; and between the Katarina canal and the Fontanka, the third Admiralty-quarter. The Styckhof occupies that part lying beyond the Fontanka, along the Neva; the Moskofskoi lies below the Styckhof, along the Fontanka; and the Rojestvenskoi, to which the Yæmskoy quarter adjoins, lies along the Ligova canal. The other quarters are the Vassilieofstroi, the Petersburgskoi, and the Vyburgskoi. The streets of this city are generally straight, broad, and long; and three of the principal ones which meet in a point at the Admiralty, are fully two miles in length. Many of them are paved, while others are merely floored with planks. The mansions of the nobility are very large piles of building, and the public edifices are magnificent. But though Peterburg is more compact than the other Russian cities, it is built in a very straggling manner; and in several parts, especially in the Vassili Ostrof, wooden houses of mean appearance are blended with the public structures.

Within the circuit of the first Admiralty-quarter, there are between 20 and 30 splendid edifices, the most remarkable of which, in point of size and grandeur, is the imperial winter-palace. In one of the squares in this quarter stands the celebrated equestrian statue of Peter the Great in bronze, of a colossal size; the pedestal of which is a large rock brought to the spot from Lachta in Finland, at an expence of 70,000 rubles. This statue was cast in 1775 by the celebrated French statuary M. Falconet, in a building constructed over the rock for that purpose. The whole expence of this master-piece of art, amounting to 424,610 rubles, was defrayed by Catherine II. and the simplicity of the inscription accords with the sublimity of the design; it appears in brass characters, on one side in Latin, and on the opposite in Russian, *Petro Primo Catherina Secunda*, 1782. Among the public buildings most worthy of notice in this quarter are, the marble palace erected originally by Catherine for the accommodation of Gregory Orlof, the college of Foreign Affairs, the Senate, the Post-office, the Loan bank, the Admiralty with its lofty tower, and the grand church dedicated to St Isaac.

The second Admiralty-quarter contains two of the principal Greek churches, the college of Medicine, the opera-house, and the court stables. In the third Admiralty-quarter, the most striking object is the Bank, which is, perhaps, the handsomest structure in the capital. The only churches of note are the Catholic and the Armenian. Of the public buildings of the Styckhof, the most deserving of notice is the arsenal, which forms an open quadrangle of three stories, and presents a dignified aspect. Though comparatively small, the Rojestvenskoi quarter contains the only monastery and the only convent in Petersburg. The archbishop resides in the elegant monastery of Alexander Nevski, and in the great church is the tomb of its saint made entirely of silver. In the Moskofskoi quarter is the imperial Yægerhof for the *corps de chasseurs*; and here likewise is situate the town hospital, which is a very elegant structure. On the Vassili Ostrof stand the Exchange and academy of Sciences, and the academy of Arts. This island is the seat of commerce and literature; and among the churches situate on it, the Lutheran church of St Catherine is chiefly remarkable for the beauty of its architecture. The Petersburg-quarter, consisting of several islands, contains the first wooden cottage of Peter the Great, with a brick building on arches erected over it, to preserve it as a sacred relic of that monarch. The citadel on the island in the Neva is the most striking object in this quarter, being 400 fathoms long, and half as broad; and having two gates, one towards the Petersburg island, and the other fronting the admiralty side, to which there is no access but by water. Within the walls stands the church of St Peter and St Paul, which contains the bones of the czar, its founder, and several of his successors; and among the other curiosities of the castle may be noticed the imperial gold and silver assay offices, and the mint. The Vyborg-quarter is chiefly occupied with the cottages of the peasantry.

In this country, during winter, the severity of the cold is such, that persons are often frost-bitten as they walk along the streets; and coachmen and servants, while waiting for their masters, are sometimes frozen to death. With the view, however, of preventing such accidents, great fires of whole trees piled one upon another are kindled in the most frequented parts of the city. By means of the Neva, with its numerous branches and canals, Petersburg is well supplied with water, and supplies of wheat are received from the countries bordering on the Volga. The Neva abounds with salmon. Sheep, hogs, tame and wild fowl, and all sorts of game, are in winter brought to the city frozen; and hence the price of them is commonly regulated by the weather and the hardness or softness of the sledge roads. From the environs of Petersburg, a great abundance of vegetables is procured; but the produce of fruit in the orchards and forcing houses, is not nearly adequate to the demands of the inhabitants. From the Ukraine, and the regions of the Volga and the Occa, fruit of the country is obtained, and foreign fruit is brought from Rostock and Stettin.

Exclusive of Russians, it is difficult to determine to what nation Petersburg is most indebted for its inhabitants; and, indeed, the diversity of nations and languages, fashions and customs, discernible in this country, are not a little remarkable. The citizens, properly so called, are not very numerous, but the whole population is estimated at 250,000. The splendour of the court is conspicuous among all ranks, who imitate it as far as their circumstances permit. As the morals of the people are rather depraved, the suspicious vigilance of the government renders it extremely prudent for a stranger to be circumspect in his words and actions. Foreigners are allowed all possible liberty of conscience, but neither the plans of government nor the articles of the Greek religion are suffered to be the subjects of their animadversion. In this city, during summer, private carriages or boats are the usual modes of conveyance from one place to another; but whenever the winter sets in, great numbers of Russians arrive with their sledges, and may be hired each at the rate of fivepence Sterling an hour; within which space, the horse, if required, will travel about seven miles. Respectable housekeepers, in general, have sledges of their own, and persons of distinction are drawn by postilions.

The police establishment of Petersburg is much admired, and consists of a police-master, two presidents, the one for criminal the other for civil cases, and two consulters chosen from the burgher class. The residence is divided into ten departments, to each of which belongs a president, whose duty it is to know the inhabitants of his own district, over whom he is appointed a censor. Each department has several sub-divisions, of which there are 42 in the whole residence; and a quarter inspector and quarter lieutenant are assigned to each of these. Besides 500 night watchmen, who have proper stations assigned them, there is a command of 120 men, who are supported, when necessary, by a regiment of huzzars. To such scrutinizing formalities are travellers subjected, that to hide the place of their residence, or the time of their departure, is found to be impracticable; and all householders are bound to inform the police what strangers lodge with them.

The present site of Petersburg was a vast morass, only occupied by a few fishing-huts, till the year 1703, when Peter the Great having conquered the adjoining country, the situation was pitched upon as being peculiarly eligible for the Baltic trade; and the city was begun by the erection of a citadel with six bastions; besides which, the czar built a small hut for himself, and some wooden hovels. The original design of Peter was merely to establish a place of arms, where military stores might be collected from the interior of the empire; but in consequence of the signal victory of Pultowa, and the conquest of Livonia, he resolved, notwithstanding many seemingly insuperable difficulties to make this the capital of the Russian empire, and to perpetuate his own name by conferring it on the new city. He accordingly ordered the castle to be built of stone, the admiralty to be walled in, and all the other buildings to be raised in a handsome manner, and with durable materials. The imperial city gradually rose from small beginnings, and a range of buildings was, in 1714, erected for the public offices, which four years afterwards were tranferred thither. The principal nobility of Russia were enjoined to build houses, and fix their residence in Petersburg; and as private plans did not answer the magnificent ideas of the monarch, he at length determined that the city should extend into the island of Wasili-Osterno. To accomplish this design, streets were marked out, canals were dug, piles were drove with vast labour, the island was fortified with numerous bastions, and the nobility were commanded to build their houses a second time. After the death of Peter the Great, the Russian nobility felt indifferent about the new city; but it continued to prosper, and the sublime intentions of the founder were fully executed under the auspices of his successors.

The account now given of Petersburg must be understood as descriptive of that city prior to the inundation which happened there in November 1824, and by which the losses were immense. Petersburg, before that disastrous occurrence, was, perhaps, one of the largest and most splendid cities in Europe.

The inundation destroyed all the bridges over the Neva, and rendered difficult the communication to the different parts of the city. The number of persons who perished has been variously estimated from 4000 to 8000—the loss of property at 100 millions rubles. Immense quantities of herrings (a million in value) were washed away. The magazines of hemp and oil, lying higher, did not suffer so much. Half the sugar in the warehouses (thirteen millions in value) was melted. Neither bread, sugar, salt, nor flour, was to be had. The casks in the cellars were staved, and wine mixed with water was pumped out of them. Many streets became impassible, from the quantity of timber, fuel, household furniture, remains of houses, &c. &c. Letters in the Lubeck Gazette said that the thermometer, which, on the preceding day, was at 0. or 1. above 0. rose on the 19th 5 above 0. At Cronstadt, the sea, rising above the great battery, laid the whole town under water, and the inhabitants were forced to take refuge in the second stories. Many merchantmen perished; the imperial navy suffered extremely, and a ship of the line, of 100 guns, was borne into the great square. The Isaac's bridge was destroyed, and its immense foundation of blocks of granite was unable to resist the fury of the waves. A large three masted vessel was driven against a house, which it carried away. The loss in bank-notes alone was immense.

PETERSFIELD, a town of Hampshire, in England, seated on the river Loddon, 18 miles northeast from Portsmouth, and 55 south-west from London. See HAMPSHIRE.

PETITION, a formal request made by an inferior to a superior, especially to one who possesses jurisdiction. So excellent are the laws of England, that for every possible wrong there is a plain and obvious remedy both against and for the crown, as well as the subject; and the petition is used for that remedy which the subject has to remove a wrong done by the king, who cannot be sued by writ. By statute I. William and Mary, stat. 2, cap. 2, it is declared that the subject hath a right to petition, and that all commitments and prosecutions for such petitioning are illegal. Care must be taken, however, that under the pretence of petitioning, the subject be not guilty of any riots or tumults. The soliciting or procuring the putting the hands or consent of above 20 persons to any petition to the king, or either house of parliament, for alterations in church or state, unless by assent of three or more justices of the peace of the county, or a majority of the grand jury at the assizes or sessions, &c. and repairing to the king or parliament to deliver such petition, with above the number of ten persons, is, by statute, subject to a fine of L.100 Sterling, and three months imprisonment. To subscribe a petition to the king, to frighten him into change of his measures, is included among the contempts against the king's person and government, and is punishable by fine and imprisonment.

PETITOT, John, an unrivalled painter in enamel, was born at Geneva in 1607. He visited England, where he was warmly patronized by King Charles I. after whose death he went to France, and was employed by Louis XIV. He painted the face and hands, and his brother-in-law Brodier added the drapery. See Design.

PETIVER, an English botanist, who was apothecary to the Charter-house, and died in the year 1718. He was fellow of the Royal society, and made so great a collection of rare and curious plants, animals, and insects, that Sir Hans Sloane, who afterwards purchased it, offered him in his lifetime L.4000 for his collection. He published several works on different subjects of natural history, and he likewise contributed a number of papers to the Philosophical Transactions. The works of Petiver were collected and published, exclusive of his papers in the Transactions, in 2 vols. folio, in the year 1764.

PETRARCH, Francis, an Italian, celebrated for great parts and learning, who has been styled the father of modern poetry, and was, perhaps, the first among the moderns in whom the spirit and genius of ancient literature began to revive. He was descended of an ancient and honourable family of Florence, but was born at Arezzo, in Tuscany, in 1304. He had the misfortune to lose both father and mother when he was about 20 years of age, after which he removed to Avignon, where he soon became remarkable for the brilliancy of his talents, and the intensity of his application to study. In 1327 he commenced an amour with a young damsel of the name of Laura, whom he has immortalised by his exquisite poetry. Various conjectures have been made concerning the identity of this female; but she is by most writers supposed to have been born of an honourable family in the vicinity of Avignon; and the poet himself says of her, "Nature formed you the most striking model of her own power: When I first beheld you, what emotions! nothing can efface the impression you then made." Unhappily for Petrarch, his love, though of the most pure and ardent kind, did not experience a suitable return. The indifference of Laura must have been very painful to Petrarch; yet to the comparative neglect with which she treated him, the world is indebted for those inimitable verses which have shed a lustre over their names. From his letters and works, it is apparent, that he experienced a degree of kindness which led him to indulge the hope of one day possessing his beloved Laura, yet he had the courage to make a vigorous effort to break the fetters by which he was enchained; he felt, in a word, that, capable of more noble undertakings, his days were ingloriously consuming in painful anxiety. Petrarch travelled into France, the Netherlands, and Germany, and, after his return to Avignon, he entered into the service of Pope John XXII. who intrusted several important affairs to his management. But nothing could abate the ardour of his passion, and restore his mind to tranquillity. "Laura appeared in every object, and was heard in every breeze." Remembering, however, the delights he had once enjoyed in seclusion and in the pursuits of literature, he, in the 34th year of his age, retired to Vaucluse, a delightful place situate 15 miles from Avignon, where, in a small house, the humble residence of a shepherd, he remained several years, and applied himself indefatigably to the pursuits of literature. The ardour with which he devoted himself to study could not efface the image of Laura from his mind. Time, indeed, seems to have strengthened his attachment for her; and, speaking of Vaucluse, he says emphatically, "Here the fire which consumed me having its free course, the valleys and even the air itself resounded with my complaints."

Petrarch was held in high estimation by the most illustrious men of his time. He gained such applause by his application to poetry, that on the same day he received letters from Rome, and from the chancellor of the university of Paris, inviting him to receive the laurel crown. Never during his life had he known a day so bright, nor was he long in suspense to which of the two illustrious cities that so highly honoured him to give the preference. It seemed to him most noble to receive his honours in that theatre which so many illustrious men had adorned. He hastened to Rome, accompanied by the Roman nobles, and, amidst the acclamations of the Roman people, a crown of laurel was put upon his head. Every corner of Italy resounded the praise of Petrarch. The lustre of his crown made an impression even on Laura. Her heart relented, her eyes discovered pity and tenderness. In the transports of his joy, the poet forgot all his sufferings: "My Laura, said he, is more gentle, her air is more serene, her look is less severe, her smile is more enchanting. When I turn to her, I see love asserting my rights." His ardour grew with every mark of her attention. It became too confident and required to be repressed. Her countenance displayed alternately complacency and softness, disdain and rigour. The agitations of his mind affected his body. He lost, in the vigour of age, that freshness of complexion, that air of health, which is so becoming. A fatal yet agreeable melancholy preyed upon his constitution, and he seemed to look forward with pleasure to his own dissolution. His dejection increased; his friends, his physicians, urged him to travel. He consented; he went to bid a last adieu to Laura. He found her in the circle of ladies with whom she lived. Nothing could be fancied more modest than her air. She had laid aside all her pearls and ornaments. Her usual vivacity had forsaken her; she was serious and thoughtful. She sung not, nor spoke with that sweetness which bewitches. Her dress, her demeanour, and a sentiment of pity, mingled with sorrow, which was impresssed in her countenance, seemed to announce the dreadful calamity that was to befal him.

When Petrarch left Avignon, he carried with him all his inquietudes. The change of situation and of objects brought not amusement. Laura was the subject of his waking dreams; and, during the night, her image perpetually presented itself to him. But it appeared not to him, as in times past, to give him consolation. His visions were gloomy, and ravished from him every ray of hope. In a state of the most afflicting uncertainty he reached Parma.

A letter he received there informed him, that the plague then raged at Avignon, and that Laura had fallen by it. On the 3d day of April in the year 1348, the usual symptoms of that cruel malady appeared on her. She knew that in three days more it would be fatal.

With Petrarch all hopes of becoming possessed of his Laura were now inevitably at an end. She died on the 6th April 1348, the same day, it is said, when 21 years ago he beheld her and became her admirer. At this melancholy event Petrarch was so inconsolable that he spent several days without food, giving way to the bitterest sorrow: "I dare not think of my condition," says he, "much less can I speak of it. Since the strongest cord of my life is broken, with the grace of God I shall easily renounce a world where my cares have been deceitful and my hopes vain and perishing."

Petrarch returned to Italy in the year 1352, when being at Milan he was made chancellor of state by Galeas Viceconti. The remainder of his life he chiefly spent in visiting the different cities in Italy. When old and infirm, he built a neat villa at Arqua, three miles from Padua, where he died in 1374 in the 70th year of his age. His remains were interred in the parish church of Arqua, where a monument was erected to his memory. The works of Petrarch, which are extremely numerous, have been published in every variety of form. His Sonnets are familiar to the English reader, through the translations of Lord Morley, Mrs Anna Hume, and others. His Latin works were first printed at Basil, in one vol. folio, in 1496, and his Italian at Milan, in one vol. folio in 1512. Of the life of Petrarch, various authors have published accounts. See *Memoirs of Petrarch*, by M. de la Bastie, inserted in the *Memoires de l'Academie des Inscriptions et Belles Lettres*, vols. xv. and xvii.; *Memoires pour la Vie de Petrarche*, by the Abbé de Sade; *Life of Petrarch*, 2 vols. 1807, by Mrs Dobson. An *Essay on the Life and Character of Petrarch*, one vol. Edin. 1810, supposed to be written by the late Lord Woodhouselee; and Watt's *Bibliotheca Britannica*, article Petrarch.

Of Petrarch we have the following elegant and just character in the life of the poet, written by Mrs Dobson:

"Few characters, perhaps, have set in a stronger light the advantage of well-regulated dispositions than that of Petrarch, from the contrast we behold in one particular of his life, and the extreme misery he suffered from the indulgence of an affection which, though noble and delightful when justly placed, becomes a reproach and a torment to its possessor when once directed to an improper object. For, let us not deceive ourselves or others; though (from the character of Laura) they are acquitted of all guilt in their personal intercourse, yet, as she was a married woman, it is not possible, on the principles of religion and morality, to clear them from that just censure which is due to every defection of the mind from those laws which are the foundation of order and peace in civil society, and which are stamped with the sacred mark of divine authority. In this particular of his character, therefore, it is sincerely hoped that Petrarch will serve as a warning to those unhappy minds, who, partaking of the same feelings under the like circumstances, but not yet suffering his misery, may be led, by the contemplation of it, by a generous regard to the honour of human nature, and by a view to the approbation of that all-seeing Judge who penetrates the most secret recesses of the heart, to check every unhappy inclination in its birth, and destroy, while yet in their power, the seeds of those passions which may otherwise destroy them. As to the cavils or censures of those who, incapable of tenderness themselves, can neither enjoy the view of it when presented in its most perfect form, nor pity its sufferings when, as in this work, they appear unhappily indulged beyond the bounds of judgment and tranquillity; to such minds I make no address, well convinced, that as no callous heart can enjoy, neither will it ever be in danger of being misled, by the example of Petrarch, in this tender but unfortunate circumstance of his character. To susceptible and feeling minds alone Petrarch will be ever dear. Such, while they regret his failings, and consider them as warnings to themselves, will love his virtues; and, touched by the glowing piety and heart-felt contrition which often impressed his soul, will ardently desire to partake with him in those pathetic and sublime reflections which are produced in grateful and affectionate hearts, on reviewing their own lives, and contemplating the works of God. Petrarch had received from nature a very dangerous present. His figure was so distinguished as to attract universal admiration. He appears, in his portraits, with large and manly features, eyes full of fire, a blooming complexion, and a countenance that bespoke all the genius and fancy which shone forth in his works. In the flower of his youth, the beauty of his person was so very striking, that wherever he appeared, he was the object of attention. He possessed an understanding active and penetrating, a brilliant wit, and a fine imagination. His heart was candid and benevolent, susceptible of the most lively affections, and inspired with the noblest sentiments of liberty. But his failings must not be concealed. His temper was, on some occasions, violent, and his passions headstrong and unruly. A warmth of constitution hurried him into irregularities, which were followed with repentance and remorse. No essential reproach, however, could be cast on his manners, till after the 23d year of his age. The fear of God, the thoughts of death, the love of virtue, and those principles of religion which were inculcated by his mother, preserved him from the surrounding temptations of his earlier life."

**PETRIFACTION**, the conversion of wood, bones, and other substances into stone. The term petrifactions is usually applied to those organized substances found on or near the surface of the earth, which are incrusted, and have their pores filled with concrete stony matters, so as to render those substances hard in process of time, and give them the appearance of stone. See *Organic Remains*, under GEOLOGY.

**PETROBRUSSIANS**, a religious sect, which arose in France and the Netherlands, in the beginning of the twelfth century. The Petro-Brussians were so called from Peter Bruys, a provençal, who attempted to reform the abuses of the age in which he lived, and was in consequence burnt in 1130 by an enraged populace instigated by the clergy. They were likewise called Henricians, from a monk named Henry, who was the chief of Bruy's followers. Peter the Venerable, abbot of Clugny, in a treatise written expressly against this sect, states their tenets to be, 1. That children, before the age of reason, cannot be justified by baptism, as it is our faith that saves by baptism; 2. That no churches should be built, but that those that already are should be pulled down; a dwelling-house being as proper a place for prayers as a temple; 3. That the cross ought to be pulled down and burnt, because we ought to abhor the instruments of our Saviour's passion; 4. That the real body and blood of Christ are not exhibited in the eucharist, but merely represented by their figures and symbols; 5. That sacrifices, alms, and prayers do not avail the dead.

PETROLEUM, or mineral oil. See CHEMISTRY.

PETRONIUS, ARBITER, a celebrated critic and polite writer of antiquity. He was one of the favourites of Nero, and became pro-consul of Bithynia; but being accused by Tigellinus, another of Nero's friends, of being engaged in a conspiracy against that tyrant, was put to death by the opening of his veins in the year 66. Before he expired, Petronius wrote an epistle to the emperor, describing his nocturnal extravagancies, and the daily impurities of his actions. By his writings, as well as by his luxury and voluptuousness, he was particularly distinguished. Of his works, the best editions are those of Burman, 4to, Utr. 1709, and Reinesius, 8vo, 1731.

PETTY, SIR WILLIAM, was a native of Romsey in Hampshire, and was born in the year 1623. Having received the principles of education at the grammar-school of his native place, he went to Caen in Normandy for the purpose of perfecting himself in the knowledge of modern languages and the mathematics. About the year 1643, he commenced the study of anatomy and medicine at Paris, where he dissected in company with the famous Hobbes. At an early period of life, he was remarkable for his inventive talents; and in 1647 he gave a proof of his ingenuity by soliciting and obtaining a patent from Parliament for an invention of the art of double writing, which appears to have been by means of a copying instrument. At Oxford, he was in 1649 appointed deputy to the professors of anatomy, and was created doctor of physic by dispensation from the delegates of the university. At this period, also, he was elected a fellow of Brazen-nose college, and became a member of a society at Oxford for cultivating natural knowledge; which institution gave rise to the Royal society. In 1652 he was appointed physician to the army in Ireland, and two years afterwards he entered into a contract for regulating the admeasurements of lands forfeited by the rebellion. Shortly after the restoration, Charles II. made him one of the commissioners of the court of Claims. The honour of knighthood was in 1666 conferred upon him, at which period he likewise obtained a patent constituting him surveyor-general of Ireland. Sir William engaged the public attention in 1663, by his invention of a double-bottomed ship to sail against wind and tide, a model of which he presented to the Royal society; and also a paper on the art of ship-building. On the subject of political arithmetic, he published a number of valuable tracts, which were collected together and reprinted in 1699. Sir William died at London 1687, leaving behind him a widow, who, in 1688, was created baroness of Shelburne, which title became hereditary in the family.

PETTY, WILLIAM, Marquis of Landsdown, an eminent statesman, was born in May 1737, and died in May 1805. He was educated for the military profession; and having obtained a commission in the guards, he served with the British troops in Germany, and shewed great personal bravery at the battles of Campen and Minden. He had the honour to be appointed aid-de-camp to King George III. with the rank of colonel. In 1766, when the Rockingham administration was displaced, Lord Chatham being called upon to form a new administration, he appointed Lord Shelburne secretary of state of the southern department, and of the department of the colonies. Finding, however, that a train of measures hostile to the liberties of America had arisen, his Lordship resigned his post. While the American war proceeded, he opposed the ministry with firmness and energy. In consequence of the death of Lord Chatham, he was placed at the head of the political connection to which he belonged. After the termination of Lord North's administration, he was made secretary of state in the Rockingham administration. On the death of that nobleman, his lordship was elevated to the office of minister; which measure proved offensive to Mr Fox and his friends. His first object was to make peace; but when the treaty was brought before Parliament, Lord North and Mr Fox had formed a coalition, and the treaty meeting with the disapprobation of the representatives of the people, Lord Shelburne resigned, and Mr Pitt succeeded to his post. The title of Marquis of Landsdown, with the honours of the Garter, were at this time conferred upon his Lordship. His Lordship continued through life to oppose the increasing influence of the crown. He urged the abolition of useless places, and proposed plans for the establishment of a rigid system of economy. He was peculiarly well acquainted with foreign politics and foreign courts, and was much conversant with the history and laws of his country.

PETTY or PETIT LARCENY. See LARCENY.

PETWORTH, a handsome town in the hundred of Rotherbridge, and county of Sussex, 49 miles west from London. It contains between 2000 and 3000 inhabitants. Close to this town is situate the magnificent family mansion of the family of Eagremont, which was erected on the site of the ancient house of the Duke of Somerset. The front of this mansion is of free-stone, adorned with statues on the top, forming one unbroken range, having twenty-nine windows in each story.

PEWTER, a compound metal, the basis of which is tin. There are three kinds of it distinguished by the names of plate, trifle, and ley. Pewter is employed in making a variety of culinary and other vessels. The most approved kind is composed of 100 parts tin, alloyed with 17 parts of antimony; to which compound the French sometimes add a small portion of copper. A very good kind of pewter is formed of a hundred parts of tin, eight of antimony, four of copper, and one of ley. Pewter contains nearly one-fourth part of its weight of lead. It is stated by Mr Parkes, that the usual mixture for pewter is 112 parts tin, 15 lead and six brass; but that many manufacturers use also bismuth and antimony in the composition. See CHEMISTRY.

PEYRERE, ISAAC LA, a remarkable French writer, was born in 1594 at Bourdeaux. The prince of Conde, who was much pleased with the singularity of his genius, made him his librarian. Peyrere was the author of *Præadamitæ, sive exercitatio super versibus*, 12, 13, 14, cap. 15, *Epistolæ Pauli ad Romanos*; and of another treatise, entitled, *Du rappel de Juifs*, which is as singular as it is scarce. He died at the advanced age of 82.

PHÆDON, a disciple of Socrates, who, after that philosopher's death, founded at Elis, his native place, a sect of philosophers who composed what was denominated the Eliac school.

PHÆDRUS, a Thracian, who was author of five books of fables, written in Iambic verse, which are esteemed for their wit and good sense. He borrowed the matter of his fables chiefly from Æsop. These fables were first discovered in the library of St Remi, at Rheims, and published by Peter Pithou about the end of the sixteenth century.

PHALANX, in antiquity, was a square battalion of soldiers, consisting of 8000 men, with their shields joined and crossing each other. The Macedonian phalanx is said to have had the superiority over the Roman legion in valour and strength.

PHALERUM, in ancient geography, a port of Athens, remarkable as being the place near which Demosthenes exercised himself in declamation. As this port was rather incommodious, the Athenians built the Piræus, and both were joined to Athens by long walls.

PHARAOH, a name which in the Egyptian language denotes a king, and was commonly assumed by the princes of Egypt when they ascended the throne. The Egyptians very probably gave this name to their kings as long as their own language continued in use; but the name was no longer known among them after the conquest of the country by Alexander the Great, when the Grecians introduced their language with their government. Herodotus informs us, that the books of the Egyptian priests contained the names of 330 kings, in which number there were eighteen Ethiopians, and a female that was a foreigner named Nicotris, and that all the rest were Egyptians. It therefore appears that every one had his proper name mentioned in the catalogue of the Egyptian kings, and that Pharaoh was not the only name by which the kings of Egypt were designated. In the Scriptures several princes are named Pharaoh.

PHARISEES, a Jewish sect who were remarkably self-righteous, and zealous for the traditions of the elders, which they pretended were delivered together with the written word to Moses from Mount Sinai. They were so named from the Hebrew word *pharic*, signifying to separate, from the circumstance of their separating themselves from those whom they considered sinners or profane. This sect, contrary to the opinion of the Sadducees, maintained the doctrine of a resurrection from the dead, and believed in the existence of angels and spirits. With them, however, the privilege of a resurrection belongs only to the children of Adam; and so gross was their belief in a future state of felicity, that they imagined the happiness of the next world would consist in the gratification of the animal passions, and the enjoyment of sensual pleasures. Among the Jews this sect was one of the most ancient and considerable. The Pharisees were in great repute for righteousness in the time of our Saviour, who frequently charges them however with hypocrisy, and making the law of God of none effect through their traditions. The greater part of the modern Jews are still of this sect.

PHARMACOPŒIA, from the Greek signifying *remedy* and *to make*, denotes a dispensatory, or a treatise explaining the different methods of preparing medicines, their uses, manner of application, &c. The Edinburgh, London, and Dublin pharmacopœias are chiefly consulted in Britain in the present day. Among the other pharmacopœias, are those of Bauderon, Quercetan, Zwelfer, Charas, Bates, Salmon, Lemery, and Lewis.

PHARMACY is the art of preparing, compounding, and preserving medicinals. For an account of the nature and design of pharmaceutical operations, see MATERIA MEDICA.

PHAROS, a small island off the coast of Egypt, which was remarkable for its light tower, which was called the key of the Egyptian sea. This tower was of such height as to be seen 100 miles off, and was considered one of the seven wonders of the world. It consisted of several stories and galleries, with a lanthern at top, wherein a light was always kept burning. See LIGHT-HOUSE.

PHARPHAR, or PHARPAR, an arm of the Barrady or Chrysorrhoas, which waters the city of Damascus and the adjacent country, and of which mention is made in Kings, v. 12.

PHARSALUS, in ancient geography, a town of Phthiotes, a district of Thessaly near Pheræ and Larissa. It is now called Farsa. At no great distance from this place was the celebrated plain of Pharsalia.

PHASES, a term used by astronomers to signify the various appearances of the moon and planets, according as they are differently situate with respect to the sun. See ASTRONOMY.

PHASIS, or RIONI, a river which has its origin in the principality of Georgia. It forms the south boundary of Mingrilia, and flows into the Black sea.

PHENICIA. See PHŒNICIA.

PHERECRATES, a Greek comic poet, who flourished in the time of Plato and Aristophanes. A sort of verse was invented by him, consisting of the three last feet of an hexameter verse, of which the first was always a spondee, and which from him received the name of Pherecratian. Of the twenty-one comedies attributed to Pherecrates, only some fragments, collected by Hertelius and Grotius, remain; from which fragments it appears that he wrote the purest Greek. Though Pherecrates introduced living characters on the stage, he never abused the liberty thus taken by satire or defamation.

PHERECYDES, a philosopher of Scyros, who was a disciple of Pittacus, one of the seven wise men of Greece, and flourished about the year 560 before the Christian era. He supported the doctrine of the immortality of the soul, as also that of the metempsychosis. Pythagoras, who was one of his disciples, erected a monument to his memory in the island of Delos.

PHIAL, Leyden. See Electricity.

PHIDIAS, the celebrated Athenian sculptor, was a cotemporary of Pericles, who flourished in the eighty-third Olympiad. The statue of Jupiter Olympius, with which this great artist concluded his labours, was always considered his best piece, and has passed for one of the wonders of the world. See Design.

PHIDITIA, in ancient history were, as the word denotes, feasts celebrated with great frugality at Sparta. As the design of these feasts was to keep up peace and friendship among the citizens, they were held in the public places and in the open air, and rich and poor assisted at them equally and on the same footing. These feasts were frequented by young persons as a school of temperance and sobriety, where, by the example and discourse of the elders, they were trained to good manners and useful knowledge.

PHILADELPHIA, an ancient town of Lydia, situated about 40 miles east south-east of Smyrna, in E. long. 28° 15′, and N. lat. 38° 28′. It is called Alahasher by the Turks, and the number of its inhabitants is now about 7000 or 8000, of whom 2000 are supposed to be Christians.

This place, which was founded by Attalus Philadelphus, brother of Eumenes, is celebrated by being the seat of one of the seven churches,—Rev. iii. 1—17.

PHILADELPHIA, the principal city of the state of Pennsylvania in North America, is situate on the west bank of the river Delaware, and is one of the finest cities in the United States.

The climate of Philadelphia is remarkably various, and has been not inaccurately characterized as a compound of all climates. The most agreeable months are April and May, September, October, November.

The environs of this city are pleasant and well cultivated. Philadelphia is intersected by numerous streets, which cross each other at right angles; and the greater part of the city is paved with pebblestones in the middle, and with foot-paths of brick. The houses, in general, are constructed of brick, three stories high, and without much ornament. Among the public buildings are, the state-house and offices, the buildings belonging to the Philadelphia library, the new bank, the theatre, the university and medical school, the city court-house, a county court-house, the philosophical society's hall, a carpenter's hall, a dispensary, an hospital and offices, an alms-house, a house of correction, a jail, a public factory of linen, cotton, and woollen stuffs, a public observatory, four market-houses, and a fish-market. The number of places of public worship is 27. The Quakers have five, the Presbyterians six, the Episcopalians three, the German Lutherans two, the German Calvinists one, the Catholics three, the Swedish Lutherans one, the Moravians one, the Baptists two, the Methodists two, the Jews one. The German Lutheran church, which was erected in 1795, is one of the most elegant churches in the United States. The state-house is admired as an elegant piece of architecture. The new bank of Pennsylvania is a spacious edifice of marble, of the Ionic order, built after the model of the ancient temple of Minerva in Greece. The building belonging to the public library company is a handsome structure, with a marble statue in front of Dr Franklin. The university was incorporated in 1791; it produces annually a revenue of about L.2365, and the students on an average amount to 570, of whom 25 are yearly admitted to degrees. The funds of the university were partly given by the state, and partly taken from the old college of Philadelphia. There is a medical school attached to the university, which has professors in all the branches of medicine; and there is, besides, a Protestant Episcopal academy, which is in a flourishing condition. The Philadelphia library owes its origin to the celebrated Dr Franklin. It was incorporated in 1742, and now contains more than 18,000 volumes, together with a museum and a valuable philosophical apparatus. Every day except Sunday it is open to every one who has an inclination for reading, and books are also given out to readers upon their leaving a deposit to ensure their safe return, and paying a small compensation for the use of them.

Philadelphia may justly be considered the emporium of the literature of America. It can boast of Dr Franklin, and many other distinguished characters, and liberal knowledge has been long diffused throughout the whole community,—so that to meet with an individual a native of this city who is not a proficient in reading, writing, and accounts, is an extremely rare occurrence. Philadelphia was distinguished even so early as the year 1795, by no fewer than 31 printing-houses, at which period it produced four daily newspapers. The number of printing-houses, of booksellers shops, and of daily and weekly newspapers, is now very considerable.

This city is remarkable for its charitable and benevolent institutions, which are conducted on the most liberal and philanthropic principles. Mr Warden, in his *Account of the United States*, says, "In the city of Philadelphia there are eight public charitable institutions, and two private; three female societies for general charity; eight free schools; fifteen mutual benefit societies; associations for the relief of foreigners, and eleven mutual benefit societies for foreigners and their descendants; St Andrew's society, German Incorporated society, St George's society, Hibernian society, French Benevolent society, the Cincinnati society, composed of officers of the army of the Revolution, for granting relief to the distressed members, their widows, and orphans. The mutual benefit societies are, the Ship-masters' society, the Franklin society, the Caledonian society, the Union society, the Friendly society, the Provident society, and some others."

Philadelphia is governed by a mayor, recorder, eight aldermen, and sixteen common council men, who make a quorum to transact business: they have full power to constitute and appoint laws and ordinances for the government of the city. The mayor, recorder, and aldermen are justices of the peace, and hold a court four times a year, to take cognizance of all crimes and misdemeanours committed within the city.

The trade of Pennsylvania is chiefly carried on from Philadelphia, and there are few commercial ports in the world where ships from Philadelphia are not found in some season of the year. In 1816, the shipping belonging to this port amounted to upwards of 101,830 tons. The principal exports are iron, brass, copper, iron utensils of every description, candles, paper, ropes, with the productions of the soil, such as wheat and flour, beef, pork, wool, leather, furs, hemp. The imports consist of all kinds of British manufactures; wine, gin, glass, from France and Holland; rum and sugar from the West Indies; teas, nankeens, silk, from China and the East Indies.

The Delaware, which is a mile broad at Philadelphia, is navigable to the city for ships of 1200 tons, and small vessels can ascend almost 150 miles nearer its origin. Though the port of Philadelphia is 120 miles from the sea, and is inaccessible on account of ice for several weeks in winter, it is notwithstanding well adapted for the purposes of commerce. The river contains sixteen public landings, about 500 feet from each other, and private wharfs sufficient for 200 vessels at a time. The Schuylkill also has ten public landings. By means of canals and turnpike roads, a connexion is opened between Philadelphia and the most distant parts of the interior; and a canal is now constructing between the Swetara branch of the Susquehannah, which is to communicate with the Schuylkill and the Delaware.

This city was founded in 1682 by the celebrated William Penn, who in October 1701 granted a charter incorporating the town with city privileges. Its length from the Delaware to the Schuylkill upon the original plan of the founder is about three miles, and the breadth rather less than one mile; but the inhabitants have gone beyond the original limits, and built north and south along the river for more than two miles. Originally there were nine streets, which extended from the Delaware to the Schuylkill, and were crossed by twenty-three, running north and south. The streets in general are of considerable breadth. In the original plan the space occupied by Water street was designed for a cart-way for the accommodation of the wharfs and stores, but it is now occupied by lofty houses, and commodious wharfs constructed of wood, into the river, where the largest ships that are in the port may lie in safety both to receive and discharge their cargoes. Dock street was formerly a swamp, but it is now rendered one of the most agreeable streets in Philadelphia, by means of a plantation of a row of Lombardy poplars on each side.

In the manners of the generality of the people of Philadelphia, it has been observed, there is a coldness and reserve which seems to imply a want of hospitality. The women are said to look extremely well in early life, but soon to lose their beauty. The sudden decay of the teeth, which has been attributed to various causes, is perhaps owing to the very general use that is made of salted provisions, and to the immoderate use of confectionary. The servants in Philadelphia consist chiefly of European emigrants, who remain in that condition only till they have acquired a little money and that kind of independence which every person may enjoy in America who is of an industrious disposition.

Philadelphia, as may be supposed, from the variable nature of the climate, is not very favourable to health and longevity. Instances are not wanting, however, of persons attaining to extreme old age, and the members of the Society of Friends, a class of men distinguished for regularity and temperance, generally see more than the usual term of years. The population of this city in 1790 was 43,525; in 1802 it was 62,000: and in 1816, the date of the last census, 92,247. The Quakers form about a fourth part of the whole population. In July and August, the warmest months in the year, the greatest number of deaths take place. Dr Morse mentions, what is unknown in the country parts of Pensylvannia, that nearly one half of the children born in Philadelphia die under two years of age, chiefly from a disease of the stomach and bowels. The city was visited by the yellow fever in the autumns of 1793 and 1797; at the former period 4000, and at the latter 1200 persons fell victims to its ravages. See Morse's *American Geography*, Mease's *Picture of Philadelphia*, and Warden's *Account of the United States*.

PHILIP II. king of Macedonia, and father of Alexander the Great, equally renowned as a legislator, politician, and warrior. After having conquered Greece, he meditated the conquest of Persia, but while he was preparing for this, he was assassinated at a banquet by Pausanias, captain of his guard, in the 24th year of his reign, and 47th of his age.

PHILIP II. son of Charles V. and of Isabella of Portugal, was born in 1527 at Valladolid. In 1554 he became king of Naples and Sicily by his father's abdication, and in 1556 he ascended the throne of Spain. He declared war against France, and was present at the battle of St Quintin, where he was in such terror that he made two vows, one that he should never again be present in an engagement, and the other, to build a magnificent monastery by the name of St Laurence, to whom he attributed the success of his arms. This last he executed at Escurial, about seven leagues from Madrid. Philip made a peace with France in 1559, and on his return to his own country his first care was to demand of the inquisitor an *auto da fé*, which was accordingly granted. His cruelty and abuse of power caused the Flemish attempt to throw off his yoke. The revolution began with the large provinces of the continent, but the maritime provinces merely obtained their liberty. In the year 1588 he fitted out his famous expedition called the Invincible Armada, for the invasion of England, which fleet was nearly all destroyed by the storm or the English ships. This enterprise is said to have cost Spain 40 millions of ducats, 20,000 men, and 100 ships. (See ARMADA.)

When Philip heard of the disaster, he coolly remarked, "I sent to fight the English and not the winds, God's will be done." He died in 1598, after a reign of 43 years and 11 months.

Though of a small size, Philip had an agreeable person, his countenance was grave, his air tranquil, and one could not discover from his looks either joy in prosperity or chagrin in adversity. As his religion was of the most corrupt kind, it only served to increase the natural depravity of his disposition, and to prompt him to the commission of the most barbarous crimes. It is an undoubted fact, however, that he possessed in an eminent degree penetration, vigilance, and a capacity for business. His character has been variously drawn by historians.

PHILIPPI, an ancient town of Macedonia, which is still in existence, though greatly decayed, and is an archbishop's see. It is situated on the confines of Thrace, in E. long. 44° 55′, and N. long. 41° 0′. This city, which took its name from Philip of Macedon, father to Alexander the Great, is remarkable for two battles fought between Augustus and the republican party in its neighbourhood. It is also famous as the birth-place of Adrastus, the Peripatetic philosopher, and disciple of Aristotle. Philippi contains several vestiges of its ancient grandeur.

PHILIPPICS, in literature, a term applied to the invectives of Demosthenes against Philip of Macedon. From the Philippics of that great orator Longinus quoted many instances of the sublime and beautiful. The fourteen orations of Cicero against Mark Antony, which cost the author his life, are likewise named Philippics. The name is usually given to any invective declamation.

PHILIPPINE ISLANDS, or MANILLAS, a group of islands which lie south-east from China, and amount to about 1200, whereof 400 are large and important. They form the northernmost cluster of the islands constituting the Indian Archipelago.

These islands present many volcanic appearances, and are subject to violent hurricanes, earthquakes, thunder, and rains. Though they lie within the tropics, they are not distinguished by that intense heat which is usually felt in places of the same parallel of latitude; a circumstance which has been accounted for from the great number of lakes and consequent moisture with which they abound. The rains commence in May and continue till September, or even longer, and are succeeded by a general spring. The winds are periodical, and prevail from three to four months. The Philippines islands are not essentially different from those of the other Asiatic islands of the same latitude.

No country can appear more beautiful; perpetual verdure, buds, blossoms, and fruit are found upon the trees throughout the year, as well on the mountains as in the cultivated gardens. The principal productions are rice and pulse of different kinds, the palm-tree, the sugar-cane, the bread-fruit tree, the mango and orange-trees, and the areca or betel nut. Timber is abundant, both for ship and house-building; and the bamboo, of which the natives construct their houses, grows to a large size. The animals commonly reared are pigs, fowls, ducks, goats, and buffaloes. The mountains abound with deer, the woods and fields with quails, and the sea is stocked with an infinite variety of fish, which may be caught either with the hook or with nets. Horses and cows have been very successfully introduced by the Spaniards. In these islands there are mines of gold and other metals, and quantities of gold are washed down from the hills by the rains, and found mixed with the sand of the rivers.

The Philippine islands have not as yet attained to much eminence in a commercial capacity, notwithstanding their advantageous position. They form, however, the centre of commerce with China, Japan, and the Spice islands, and they connect the Asiatic and American commerce. They likewise carry on a small trade with the Chinese, with the Malays of Borneo, and the British, in our settlements in India.

The natives of these islands are generally tall and well made; in some places they go naked, in others they wear a kind of loose shirt, with loose drawers, and in other respects they exhibit slight variations of character, as may indeed be expected from a people (though of the same origin) so little connected and scattered over so many islands. The original inhabitants consist of the various tribes of Bisayan Indians, and the stranger race of oriental negroes by whom the Papuan isles are still occupied. The Papuas, who are at present few, and whose power is limited, bear a remarkable hatred to the Bisayans. The Tagala race is chiefly found in the island of Luzon. Several other tribes inhabit these islands, such as the Pampangos, who reside to the north of Manilla, and the painted race called by the Spaniards Pintados. The great characteristic of the natives of the Philippine islands is a tendency to piracy, in which they are remarkably dexterous and enteprising. They have ever been distinguished, however, by indolence and want of enterprise, and the harsh treatment they have uniformly experienced from the Spaniards has subdued all ambition to acquire the spirit and manners of a refined people. The insecurity of property, and the disasters with which the islands are frequently visited, may be regarded as the chief causes of their indolence and inactivity. Rice is their chief article of food. Their houses are constructed of bamboos, covered with palm-leaves, and elevated on pillars. The Tagala, or the Gala language, is among these islanders what the Hindostani is in Hindostan Proper; and of the various dialects a few are current in several islands, but the most general are the Tagala and Bisaya. Laws are established in these islands; and of the crimes which subject to punishment, adultery is considered the principal.

Of the Philippine islands the principal are Luzon or Luconia, Magindanao, (already described,) Tandago or Samar, Masbate, Mindora, Luban, Paragoa, Panay, Leyte, Bohel, Sibu, Negros, Sogbu, St John, and Xolo. *Luzon*, which is the largest and most considerable, is of a triangular form, yet is said to extend 400 miles in length and 150 in breadth. It is intersected from north to south by a chain of mountains, from which diverge various ramifications that spread over the whole island. The sea coast is indented by a number of bays and commodious harbours: but that of Manilla, the capital, is the only one frequented by ships of burthen. The climate of this island is temperate, and the soil productive. In the interior there are several lakes, the largest of which is by the Spaniards called Laguna de Bay. From this lake issues the Manilla river, which may be ascended in boats. Luzon isle contains several volcanoes, one of which, namely, that of Mayore has the form of a sugar loaf, and is of such altitude that it may be discovered a great distance at sea. It also contains a number of warm springs and small lakes, which seem to indicate an internal combustion, from which perhaps originate the earthquakes to which the island is subject. An earthquake happened in 1650, which proved very destructive. Several establishments belonging to the Spaniards, and consisting generally of monks for the propagation of the Roman Catholic religion, are scattered over the island. Manilla, the capital of this island, is finely situate on the bay of the same name, and is a large and well built town, containing some elegant churches and other buildings. It enjoys an advantageous position with respect to India, China, and America for commercial intercourse, but its trade has never been encouraged. The population of the city and suburbs was in 1785 supposed to amount to 38,000, among whom not more than 10,000 or 12,000 European Spaniards were reckoned, the rest being mulattoes, Chinese, and Tagalas, who cultivate the soil, and carry on the arts of industry. The monasteries and convents occupy the largest and best part of the town. The native Indians construct their houses of bamboos, and cover them with leaves. Though the adjacent country is fertile, and adapted for any sort of culture, it has been little improved by the Spaniards, so that it remains almost in a state of nature. The sugar-cane thrives well, but little is manufactured, and the woods abound with a species of bastard cinnamon. The cocoa of the island is considered superior to that of America, and the tree is much cultivated owing to the quantity consumed by the Spaniards. The tobacco is well adapted for making segars, which are usually smoked by the Manilla ladies. Manilla exports cordage, resinous substances, pitch and tar, cloths, rushes, indigo, rice, and cotton. In 1811 the imports to Bengal from Manilla amounted to 2,969,942 sicca rupees, and consisted chiefly of copper, indigo, and cochineal, with a large proportion of treasure: the exports to Bengal and Manilla were only 1,270,542 rupees, the market having been glutted with Bengal goods in 1809.

The Philippine islands in general are characterised by beauty, fertility, and diversity of physical aspect, and they also present volcanic appearances. Those of them that remain unconquered have each its own sovereign and its own laws; but the aboriginal inhabitants of the whole are of the same race, and are still characterised by similar manners and customs.

*History.*—These islands were first discovered by Magellan, who took possession of them in name of the King of Spain; and as he landed on them on the anniversary of St Lazarus, called them the Islands of St Lazarus in honour of that saint, which name they retained till the year 1564, when a Spanish fleet having been sent out to make a conquest of them, they received the name by which they are now generally designated, in honour of Philip II. They have been long denominated the Manillas, and they have also been called the Bisayas, or Islas de Pintados, or Painted islands, in reference to the circumstance of the natives having been accustomed to paint their bodies. The Spaniards became masters of the Philippine islands slowly, nor are they yet masters of the whole group. A fleet sailed from the island of Panay, for Luzon, in 1570, when a settlement was effected at the mouth of the Manilla river. In the following year the town of Manilla was constituted the capital of the Spanish possessions in the Philippine islands. Several vessels from China afterwards arrived with merchandise, and a number of Chinese settled in Luzon, much to the dissatisfaction of the Spaniards. In 1574 the colony of Manilla was attacked by Chinese pirates, who were repulsed after many bloody engagements. When the Dutch established themselves in India, a war began between them and the Spaniards, which continued for about half a century. In the mean time, natives from China had emigrated thither to such an extent, that, in 1639, their number was increased, on these islands, to 30,000; but, at that period, the Spaniards made an attack upon them, in consequence of which they were, erelong, reduced to 7000, who surrendered at discretion. A deep-rooted prejudice against them had long been entertained by the Spaniards, which prejudice still continued after the havock just mentioned; and in 1757 they were all dispatched to their own country by the viceroy of the Philippine islands, who, at same time, appropriated a particular place for the reception of such Chinese as should come in a commercial capacity, and made regulations for their re-embarkation. In 1762 the Spanish settlements on the Philippine islands were attacked by forces from the East Indies, under the command of Admiral Cornish and General Draper, and, after a siege of twelve days, the city of Manilla surrendered at discretion. Manilla, with the port of Cavite, remained subject to the British till 1764, when these conquests were given up to the Spanish, in consequence of peace having been restored between the two nations. The Spanish colonies in these islands have not been disturbed since that period by any European enemies; but they have been much infested by the piratical forces of those islands not subject to the Spanish government. The Spanish government of the Philippines published, in 1809, a declaration of their adherence to Ferdinand VII. and opened their ports to the British; and a brisk trade has since that period subsisted, although greatly injured by the revolutionary warfare in Mexico.

According to recent intelligence from the Philippine islands, they seem disposed to follow the example of the South American colonies, in throwing off their dependence on their common mother country,—Spain. This, no doubt, arises from causes deeply seated in the political interests of the country. These islands carried on a trade with China and the East Indies; in order to support which, they had to await the arrival of the specie conveyed by the galleons from Acapulco, on the western coast of

Mexico. Spain furnished nothing, and received little from them. Now that not Acapulco only, but every other port in South America, is thrown open to their trade, their prosperity (if independent) must hourly increase. This consideration furnishes the true secret of their late proceedings; and when they hear of the wise measures adopted by Great Britain, both with regard to the Spanish colonies and also to her own, it is to be presumed that they will altogether abandon their connection with Spain. There was formerly, and perhaps still is, in Spain, a great trading association called the Royal Philippine company; but it did little or nothing for the real benefit of these islands. It had factories at Canton and Calcutta, and purchased commodities there. According to its charter, the Philippine company should have made all its imports direct from its own establishments; but, in fact, it used to buy large quantities of goods in London, from the English East India company; so that there was little real connection between Spain and the Philippine islands. See *Voyages* of Magellan, Dampier, De Pagés, La Perouse, and Forest's *Voyage to Papua*.

PHILIPS, Ambrose, an English poet, was descended of a respectable family in Leicestershire, and was educated at St John's college, Cambridge. His Pastorals, written during his stay at the university, attached celebrity to his name; and when he quitted the university, and removed to London, he obtained the friendship and intimacy of Steele, Addison, and many other distinguished characters. About the year 1709 he went to Copenhagen, where he wrote his much admired lines to the Earl of Dorset; and after his return, he chiefly employed himself in translating Persian tales for Tonson the bookseller. His tragedy of the Distressed Mother was brought forward at Drury-lane in 1712, and gained him great reputation. Philips afterwards became editor of a periodical paper called the Freethinker, which was printed collectively in three volumes, but has been long since forgotten. He died in London at an advanced age in 1748.

PHILIPS, John, an eminent English poet, son of Dr Stephen Philips, archdeacon of Salop, was born at Bampton in Oxfordshire, in the year 1676, and educated at Winchester and Oxford. The Splendid Shilling, which has been styled the finest burlesque poem in the English language, and a didactic poem on Cider, founded on the model of Virgil's Georgics, are his principal productions, and the latter piece especially raised him to eminence among the poets of his time. He also celebrated the Victory of Blenheim in competition with Addison, but his production on this occasion added little to his reputation. Philips studied the writings of the poet Milton with great application, and traced him in all his successful translations from the ancients. He died at Hereford in the 33d year of his age, and a monument was erected to his memory in Westminster abbey by Sir Simon Harcourt, with an epitaph composed by Dr Atterbury. "His addiction to tobacco," says Dr Johnson, "is mentioned by one of his biographers, who remarks, that in all his writings except Blenheim he has found an opportunity of celebrating the fragrant fume. In common life, he was probably one of those who please by not offending, and whose person was loved because his writings were admired."

PHILIPSBURG, a fortified town of Germany, seated on the Rhine, seven miles south of Spire, twenty-two south-east of Worms, and forty northeast of Strasburg. It is fortified with seven bastions and several advanced works, and is regarded as one of the bulwarks of the empire. See Germany.

PHILISTINES, the ancient inhabitants of Palestine, were descendants partly of the Casluhim, and partly of the Caphtorim, who sprang from Mizraim, the son of Ham, who was the son of Noah. In the sacred writings they are sometimes named Cherethites and Caphtorims. The Casluhim and Caphtorim, it is supposed, came originally from Egypt, and called the country which they had conquered by their own name.

PHILO, a Jewish author, who flourished at Alexandria during the reign of Caligula. In his writings, the doctrines of Plato and Moses are promiscuously blended, so that to assign to each his principles is not an easy matter. The works of Philo relate to the creation of the world, to sacred history, and to the laws and customs of the Jewish nation. The best edition of them is that of Mangey, 2 vols. folio, London, 1742.

PHILOCTETES, in fabulous history, was one of the Argonauts, and the faithful companion of Hercules, who, at his death, made him swear that he would not make known the place where his ashes were interred, and presented him with his arrows dipped in the hydra's blood. On the tenth year of the Trojan war, the Greeks being informed by the oracle, that without the arrows of Hercules, which Philoctetes then possessed, Troy could not be taken, commissioned Ulysses and Pyrrhus to go to Lemnos, and to prevail upon him to come and complete the tedious siege. With great reluctance Philoctetes consented. His adventures and sufferings form the subject of one of the finest tragedies of Sophocles.

# PHILOLOGY.

Definition.

PHILOLOGY, a compound term derived from two Greek words signifying *lover*, and *word* or *discourse*, is now commonly used to denote that science which has language in general for its subject, comprehending grammar, rhetoric, poetry, criticism. Its essential principles have been delivered under LANGUAGE, but require farther discussion in this place.

Grammar is the art or science of using language correctly, so as to accomplish those effects and objects for the attainment of which language is employed. Language, in its most extensive sense, is the expression, by whatever means, of the thoughts, feelings, and intents of a sentient, intelligent being, so that they may be communicated to, and understood by, other sentient and intelligent beings, and excite or suggest in them corresponding ideas and emotions. On the supposition that human nature is substantially identical throughout the world, the essence of grammar must be the same in all languages; and, again, the peculiarities in the kinds, the composition, the construction, and arrangement of words, in different languages, must be held merely incidental. Grammar, then, is with propriety divided into *universal* and *particular*,—the former signifying the common or generally recognized principles of language, and the latter those which characterize different dialects; or, as Lord Bacon has expressed himself, " The duty of grammar is of two natures,—the one popular, which is for the speedy and perfect attaining of languages, as well for intercourse of speech as for understanding of authors; the other philosophical, examining the power and nature of words, as they are the footsteps and prints of reason.' Here, the word *reason* must be taken to mean not only the intellectual portion of our nature, but every faculty or power of our constitution which is naturally capable of expressing itself so as to be understood,—for, in reality, all our affections, propensities, and passions, have their peculiar objects to which they address themselves in what, properly speaking, is a rational method, and, consequently, afford " footsteps and prints" by which their course is indicated, and may be followed by those who possess corresponding powers. It is obvious, that a system of philosophical grammar, that is, the science of grammar, in the most comprehensive sense, must be subsequent to the discovery and knowledge of the mode and the objects of the exercise of our various powers; and, it is equally so, that what are called the rules of grammar, considered in relation to any particular language, are the results of observations made on the use of it. In these two facts, we have, on the one hand, the origin of all the difficulties and disputes which have perplexed and agitated those who have undertaken to explain the nature of grammar in the abstract; and, on the other, are furnished with a mode of accounting for those irregularities of expression and exceptitious inconsistencies which occasion so much trouble in the acquisition of every known tongue. Philosophical grammar, it seems, then, is not confined to words, but may be said to have place in all those forms of expression, whether by the features of the face, the modulations of the voice, or the action of any of the bodily organs, by which our internal emotions and thoughts are made known; and, in this respect, it bears a very marked relation to logic and rhetoric, so far as these are merely natural, and can be carried on without the aid of artificial or arbitrary language. Taken in this manner, we may define LOGIC " the art of thinking or reasoning correctly, so that we may either arrive at truth or expose error and falsehood;" GRAMMAR as " the art of expressing what we mean, so that we may be distinctly understood;" and RHETORIC as " the art of illustrating and enforcing our meaning so as to persuade others to think or to do what we wish." Admitting these definitions, we might refer logic to philosophy, in the large or transcendental sense of the word, the object of which is the discovery of truth, as prompted by and necessary to the gratification of the love of wisdom; or we might refer it simply to truth: grammar, again, would properly fall to be considered under the present title, or, more strictly, under LANGUAGE, as the means by which we express ourselves: and, lastly, rhetoric might be treated under some such word as SPEECH, ORATORY, DISCOURSE; or, more properly, would form one of the chief topics of a large department of science, hitherto, it is believed, not furnished with a distinguishing name, under which might be comprehended all the questions and discussions respecting motives, influences, causation, and effects, so far as known intelligences and sentient beings, especially mankind, are concerned.

Of Grammar.

The grammar of natural language has hitherto been little cultivated, except by those artists whose profession leads them to study the variations of the countenance and the postures of the body, as influenced by and indicative of the different passions and affections of the mind; and even these individuals have in general rather contented themselves with imitating the antique statues, which, for reasons easily assigned, are far from being unexceptionable, than had recourse to original observation. Le Brun's work on the Passions, famed as it has been, and certainly not destitute of merit, is nevertheless so exceedingly faulty as to prove a very erroneous guide; and Lavater, eloquent and ingenious as he is, deals too much in hypothesis and the workings of fancy, to be safely trusted. Mr Charles Bell's Essays on the Anatomy of Expression in Painting, are entitled to the distinction of being the only work, really scientific, to which a student may be confidently referred for correct views of the subject, although, it must be admitted, some of his opinions are startling, especially his seeming to deny, as in the fourth essay, the existence of " a peculiar and instinctive faculty," by which the external signs or characters of the passions are interpreted by an observer.

It is obvious, that this part of grammar would be left imperfect, if the tones and inflections of the voice, considered merely as natural, and not the result of education or imitation, together with any other species of natural language, if there be such, not comprehended in the province of the artist, were not also subjected to scientific examination. The instruments furnished by nature, for the expression of our internal emotions, indicate only the states of our sentient principles and the exercise of our various powers. They do not signify any external objects, however these may operate upon us, and although we may, by means of our bodily organs, point to them as the sources or occasions of new feelings or modifications of our being. The grammar of natural language, then, would seem to be much confined as to its elements, and almost entirely to exclude one class of words, namely, substantives, or the representatives of things, which contains every object in the universe. It was attempted to be shewn, accordingly, in the article Language, when explaining the theory of the late Dr Murray, that the VERB is the primary part of speech, and that all other species or classes of words have been derived from it. A recent author, not less eminent for energy and discernment of mind than the originality of his views, to whatever topic he chooses to address himself, has not only called in question the accuracy of that theory, but, in the course of his speculations, has endeavoured to explain the nature and purport of language, in a manner and with a degree of evidence which absolutely demand marked attention and respect. The following account of his work, namely, "Anti-Tooke, or an Analysis of Language," will most profitably occupy the space allowed for this department of philology, and prove, at least, one salutary, though, it must be owned, mortifying truth, that *the philosophy of grammar is still in its infancy.* "Every man of education," says Mr Fearn, the gentleman now alluded to, "when he happens to listen to the articulate effusions of a plough-boy, or untaught peasant, is filled with unmixed compassion to behold a large number of his fellow creatures chained down, by their lot, to the dark necessity of expressing their ideas in a way that approximates, not a little, to the instinctive signs of brute animals. What, then, must be the reflections of the educated man, if it were had in proof, that, with regard to *this* sort of attainment, he is in a state not much elevated above the level of the clown whom he pities and despises?" From the title of his work, a direct opposition to the peculiar views of Mr Tooke is to be inferred; and, accordingly, it is one of his main objects to show, that the light thrown by that gentleman on the subject of speech, and "by his most meritorious successors," among whom he ranks Dr Murray, although great "in its kind," is not of *that kind* that could illustrate the structure of language; and, in point of fact, *has not, in any material or consolatory degree,* lessened that ignorance which has hitherto so nearly levelled the scholar and the clown, with regard to it."

Mr Fearn conceives there are two very different methods by which an exposition of the nature of language may be attempted; and that Mr Tooke has been injudicious in the choice he has made between them. The first method is "to demonstrate, or at least *assume,* some general principles of relation between our ideas; and, thence, to seek out, in the reputed imports of the different *species of words,* in any language, such *grammatical meanings,* as might reduce them to a strict conformity with this structure of relation;" the other is, "without any consideration whatever of the nature of our ideas, or their connections, to '*dig*' down, as far as may be done, into the unknown number of strata which the accumulation of ages has heaped upon the original forms and particular imports of words; and, thereby, endeavour to determine what these *primitive grammatical* imports have been." The latter method is that which has been prosecuted by Mr Tooke, and, since his time, by other etymologists. The former is that which Mr Harris, labouring, it is allowed, under erroneous views of relation, and some preceding writers on philosophical grammar, adopted, and which Mr Fearn himself professes to follow, but with a "view of the category of relation altogether incompatible with that heretofore uniformly entertained." Admitting that these two methods are the only methods by which an exposition of the nature of language may be attempted, and passing over sundry pointed animadversions on Mr Tooke's inconsistencies as a philosophical inquirer, and contradictions as a writer, let us attend to that "GENERIC STRUCTURE OF THE CATEGORY OF RELATION," which Mr Fearn makes the basis of his own analysis of language. The real nature of that category he conceives to be misapprehended to "a most profound and surprising degree;" and the consequence has been, "that all men of letters are lulled into such a security of prejudice with regard to it, that it can be no easy matter to rouse them to a *suspicion of its fallacy;*" while, he ventures to believe, that "it demands *nothing more than description* to bring all parties over to a full conviction that the past doctrine of the subject has been as seriously erroneous," as he supposes it to be. He aims, therefore, at nothing but simplicity in the foundation of language," and asserts, that "the foundation of language, and language itself, which must strictly conform thereunto, are, in their *generic nature,* EMINENTLY SIMPLE things, although each of them involves a very large field of reasoning or investigation." This will be readily admitted, when, besides considering the important bearings of language itself, it is understood, that, by its foundation, according to Mr Fearn's views, *i. e.* the *generic structure of relation,* which forms also *the primary object of the logician,* is signified the "*generic logical structure of things in the universe.*" It follows, that the error of the grammarian has its origin in the misconception of the logician, regarding the "real structure of relation." This, Mr Fearn endeavours to explain, substantially as follows:

In contemplating any *couple of objects,* suppose two houses, or two banks of a river, with respect to the distance between them, we would, says Mr F., if the question were asked, naturally say, that either of the two is distant with respect to the other; and, if asked, farther, for what reason we say so, our answer would be, that each of the two is said to be distant from the other, owing to a *thing that is interposed between* the two, which thing, when spoken of absolutely, is called *length*, or *linear extension*, but, when viewed in relation to any two things, is called *distance*. From this it is inferred, that the two objects are considered to be *relatives* or *co-relatives* to each other, by reason of the *distance that is interposed* between them, or, to express the matter in another way, the two objects are considered as being two co-relatives, not merely in virtue of any quality or attribute of either of them, but, principally, in virtue of a *third thing*, namely, that thing interposed between the two, and which, with respect to them, we now call distance. This third thing, then, is *foreign* to both, and "as *external to each*, as an arc or line that subtends an angle is external to and distinct from *the legs of that angle*." Thus far, Mr F. conceives, every grammarian and logician would concur in opinion; and it is imagined, that any subsequent deviation is the result, not of any controverted investigation of the subject, but of *mere oversight*, "unsuspected by any one." But the consequence of such oversight is a sweeping one; for, says Mr F., this correct conception of the nature of relation is "diametrically opposite to that which has been entertained of it by all grammarians, and all logicians, from Aristotle down to Tooke inclusive." No wonder, if this be true, that the philosophy of language has been so extensively misapprehended and confounded.

To make out a proposition of such alarming universality and such formidable influence, Mr F. proceeds to demonstrate, that, whereas, according to the just construction of the matter, "the *generic structure of relation, or of things in the universe*, is made up of what may be called *logical clusters*, containing *three things each*, namely, *two related subjects, and a relation or link of connection* interposed between them; the doctrine of all the logicians is, that the generic structure of relation, or of the universe, is made up of logical clusters containing only two each, namely, one *related subject*, and *another subject its correlate*, each viewed with reference to the other." The difference between these two doctrines is assuredly great, and highly essential,—because, as the universe is made up of "nearly one-half of these links, or third things, which connect related subjects together," and which are "objects of the very first logical magnitude and importance," they must be represented in language by a *principal part of speech exclusively appropriate* to them," which part of speech, however, "*can have no existence* in any grammar that assumes relation as consisting only of two related subjects referred to each other, without any link or third object between them." So strong is his conviction of the truth and value of this observation, that he does not hesitate to assert, it is just as possible to erect a science of geometry on the assumption of every triangle containing only two angles, as to erect a science of language on the assumption of relation consisting of clusters of two related subjects, without any third thing logically connecting them. An objection of some force might be urged against this analogy, but, as it is introduced merely in illustration, it may be passed over as immaterial. We proceed, then, to notice what is advanced, touching the origin and the universality of the erroneous opinion on the subject of the generic structure of relation. The former is imputed to the mathematicians, who are asserted to have been led into the mistake by "not having their attention engaged in such vulgar and obvious relations" as that which has been supposed in the examples regarding distance; but "having usually to do with relations of the most *subtle nature*, and which, therefore, *escape due observation*." Here Mr F. is not quite correct, and has exposed his theory, or rather, the materials by which he defends it, to a formidable assault; for, in opposition to what has just been stated, it may be, and in reality is maintained, with no small appearance of propriety, that the relations with which mathematics are chiefly occupied are among the simplest and most obvious which the mind of man can make the subject of contemplation and comparison. The truth seems to be, that the kinds of relations existing among the objects around us, are obvious and simple in various degrees to different individuals, according to the peculiarities of their own constitutions. Mr F., if aware of this fact, ought to have made allowances for it. Besides, it was quite enough to have stated it as highly probable, that the influence of mathematicians had occasioned what he holds to be an error, without at all entering on the question as to the relative simplicity or complexity, obviousness or obscurity, of the relations referred to. He is, moreover, guilty of, at least, an apparent contradiction, because, after having admitted that mathematicians have "*usually* to do with relations of the most subtle nature," and that "the logicians have founded *all their views* of relation upon *those of the mathematicians*," he positively denies the science of the former being the science of relations. But here he has his answer, for he asserts, that its "primary or principal object is only the reciprocal *relativeness* of one quantity to that of another;" and that the *relation* itself, which, in this case, is "a *logical partition called difference*," is neither furnished with a name, ever attended to, or even suspected to exist, by the mathematician. It would not be difficult to point out some inaccuracy in this part of his argument; but, in reality, it does not very materially affect his general views. As to the fact, again, of the universality of the error which it is his object to expose, Mr F. is rather more sparing of evidence than readers who feel an interest in the question would wish. His proofs are taken from a narrow range, and include very few names; those only, indeed, of Harris, considered in his double character of a philosopher and a philologist; Barrow in his capacity of a mathematician; Locke and Mr Hume as metaphysicians; and, lastly, Mr Tooke as a logician and a grammarian. His quotations from those authors may be allowed to bear out his inference, that, in regard to the notion of relation, they differed widely from him; and that for those "middle things," which he discerns as necessary in order to related subjects being what they are, they made no provision in their general system. It is a little hard, nevertheless, that other writers should be passed over *sub silentio*; and, clearly, a more enlarged inquiry and adduction of witnesses would be desire-able. There cannot be a doubt, that these are the leading authorities, and represent almost all the variety of writers on the subjects to which they devoted their powers. It is true, likewise, that the common works on logic would, in vain, be interrogated as to any difference in sentiment, or had recourse to for a ray of light to point out the distinction for which Mr F. contends. Still there are original thinkers, whom it would have been worth while to have consulted with a view to it,—and, as a proof of this, it may be mentioned as a curious circumstance, that one of the first books to which the writer of this essay turned, when he had read this portion of Mr F.'s analysis, was found to have almost exactly hit upon the idea which that gentleman has endeavoured to substantiate. It is the *Medicina Mentis* of Langius, at the 666th page of which, in the edition printed Berolini 1708, we have the following brief notice of the term in question : " Relatio est modus, quo, ob certum vinculum aut fundamentum, unum respicit alterum, seu *relatum* ad *correlatum* refertur, v. g. *Inter praeceptorem atque discipulos est relatio ob vinculum seu fundamentum disciplinæ.* Confer hic logicas vulgares, et vide ineptas ambages." It is exceedingly probable, that this author had more than a *vague* conception of the nature of Mr F.'s *links* or *middle things*, and was well aware of the inaccuracy of the school logicians. Mr F., however, is in all probability quite correct as to the *generality* of the error which he exposes.

It is hardly necessary to state here, what every metaphysical reader will, as a matter of course, understand, that, though the particular relation to which Mr F.'s reasoning refers be that of distance, the category of relation comprehends a vast variety of species. Still, however, he holds, that the generic principle of relation must run through, or be contained in, " *all the species and every individual instance of relation in the world* ;" and that, " as, in such an obvious relation as that of distance between the two banks of a river, there is, of necessity, a middle or third thing interposed between the two banks, so, in like manner, there must, of necessity, be an analogous middle or third thing interposed, in a logical sense, between any greater and any less figures in geometry that are compared together, even although it should be very difficult, or altogether beyond our ability, to demonstrate distinctly this middle thing ; and the same reasoning must apply to every instance of relation, the most occult or the most evanescent whatever." It follows, as a necessary consequence, that the relativeness of and the relations between things are the cause, foundation, or object, not only of language, but of all philosophy, logic included. We have at present to confine ourselves to language, and that not as elucidated or capable of being elucidated by etymology, which, according to the views just stated, cannot be expected to be more useful in explaining the principles of grammar than it has already been, but considered simply as a SIGNATURE and a RECORD OR MONUMENT OF THOUGHT.

In maintaining this idea of the nature of language, Mr F. avails himself of the illustrations afforded by the science of algebra, in the signs of which we have a perfect model of logical signification, or, so to speak, a scheme of notation, consisting of symbols and characters, by which the various relations between the subjects of reasoning are expressed in a manner absolutely true ; whereas, with respect to all the ordinary or popular languages, cultivated as they may have been to the utmost possible degree, it is affirmed, that the most enlightened individuals among mankind are so far from being distinguished from the ignorant, that they have never known what general notions or ideas of relations between things they had, or ought to have had, in their minds, when they employed the signs therein established. The two systems are considered to agree in principle so far, that each consists of two and only two kinds of signs,—those, namely, of subjects or quantities, and those of operations between these subjects or quantities ; but, not to take notice of the difference in the kinds of the subjects or quantities, denoted by the signs employed in the two systems, there is a vast superiority on the part of algebra, in the degree of efficiency possessed by its signs of operations, over that which exists in the case of ordinary language. Two analogous peculiarities in the two systems have now to be mentioned, with a view to expose the errors of those who have undertaken the illustration of the principles of philosophical grammar.

The operations in algebra may be conceived to be instances of certain logical actions between the quantities operated on ; and they are represented by signs, which serve as *bridges of logical connection.* Any one of these signs of action, then, must have a sign of some quantity on each side of it. Now, verbs are precisely in ordinary language what these signs of action or operation are in algebra, and equally require the sign of a quantity, that is, a noun, on each side of them. They are, in reality, *bridges of grammatical connection* between the nouns which they divide. But, obvious as this truth is held to be, it is virtually denied by all who maintain, as is usually the case in accredited grammar, that any class of them is incapable of having or taking a noun or sign of a quantity on each side ; and, of course, so far as this denial extends, the identicalness of the two systems is opposed, and an essential contrariety between them assumed.

In algebraic notation, the signs of quantities never express, and can never express operations. These are exclusively expressed by their own signs, namely, those of addition, subtraction, multiplication division. But, in ordinary language, according to the erroneous conception of it generally entertained, some of those parts of speech denominated prepositions, which really are signs of operations, are held to be verbs, and others to be nouns, a notion which would be equivalent, in the case of algebra, with the assertion that some of the signs of addition, subtraction, &c. are signs of operations, and others signs of quantities. Both Mr Tooke and Dr Murray are chargeable with this inconsistency ; and it is rendered the more glaringly absurd by this very circumstance, that the parts of speech, namely, *imperatives*, into which, considered as verbs, it is imagined, some of the prepositions are capable of being construed, are so totally different from verbs, that they are examples of *abbreviated whole speech.* On the whole, it

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is inferred, that there exists both a generic and a specific identicalness of the two systems of notation, that of algebra and that of common language, and that the supposed difference between them results altogether from misconception of the real structure and elements of ordinary speech.

One of the consequences of this identicalness bears decidedly on the nature and structure of grammar. It is enough to state it, in order to stimulate attention and enquiry. The signs of operations in ordinary language may be deemed expressive of the various relations between the subjects denoted by its nouns, and that, too, as definitively and precisely as is effected by the corresponding signs of algebra. The signs in the former case, about which, it is contended, there has long reigned the most profound ignorance, are those parts of speech usually styled verbs, prepositions, and conjunctions; the number of which, especially the prepositions, is much greater than is generally believed, and, contrary to a common opinion, is greatest in the most perfect language, and among the most enlightened people.

But the result of the discovery and establishment of the identicalness between the system of algebraic notation and that of ordinary language, is important much beyond the sphere of the grammarian. We may prove from it, that the assertion of some philosophers which has prevailed extremely in modern times, namely, that "a language or notation is the same thing as a science itself," or, conversely, that "a science is nothing but a language well arranged," is utterly erroneous. In opposition to this, it is maintained, that, whereas a science or analytical method consists in a rule from which one truth, or series of truths, of relation, results in the indication of another, deduced by the mind as a necessary conclusion from the premises,—language is not a rule regarding any truth, or any deduction whatever, out of its own peculiar grammatical construction, and, in reality, has "no election for truth more than for falsehood." In this respect, the two systems are quite alike; for, so far as the mere symbols of language are concerned, it is as correct *grammar* to say, "colour or sound loves virtue," as to use the expression $2 + 2 = 4 + 4$. In other words, in such case, the grossest nonsense may be spoken without the slightest departure from *good language*; as, in the other, the most glaring falsehood may be asserted without any violation of the rules of symbolic notation. It may be stated as a curious and not unimportant confirmation of this remark, that, in the other branch of mathematical science, namely, geometry, many of the demonstrations are actually effected by means of false phraseology and absurd assumptions. A language and a science, therefore, are two very different things, and the semblance which exists between them is so very general and loose, that the former can hardly be considered as any thing else than a shadow attendant (in the case of human beings, it is allowed, necessarily attendant) on the latter. They are so far from being of the same nature, that the parts of one of them, namely, the substance, are permanently connected together by those laws of organization which it is the business of the philosopher to investigate; while the parts of the other, namely, the shadow, have only a temporary shape and contiguity, because, and so long as they are, attendant on the former. Still, it is contended, that language is an art founded on a science of its own kind; and, farther, that there is the same kind of reciprocal dependence between the signs of quantities and the signs of operations in ordinary language that there is between those of quantities and operations in algebra. The only difference on this point is, that in the latter any concatenation of signs must express true relation; whereas a concatenation, perfectly unobjectionable as to grammatical language, may express either truth, or falsehood, or nonsense. Language may be said, therefore, contrary to the opinion of several eminent authors, not to furnish the occasion and the means of analysis, but simply to present the signs or record of analysis, after the mind itself has furnished the occasion and the means; and, consequently, it may record the rule discovered by the mind, but affords no means of making the discovery. Again, also, contrary to an established opinion, languages do not resemble "*finger-posts* placed on a road to enable us to discern our way," but resemble a *way* or *road itself*, which conducts us, or along which we are conducted somewhere, be it to truth or to fiction, to science or to nonsense. It follows from this, that single words, considered merely as signs, cannot point either forward or backward, but denote ideas which are regarded as relatively present, and, to keep up the figure, resemble *stepping-stones* in a road.

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On the same principle, it is maintained, that, though language be a *road of signs*, corresponding to and suggesting a *road of thoughts*, it is no more *an instrument of thought* than a road is an instrument of travelling. Here, says Mr F. "the real instruments of travelling (unless we adopt some secondary or artificial power) are our limbs, actuated by the powers of our body: and the real instruments of thought are the faculties of our minds, actuated by our will. It is a faculty of our mind that steps from word to word, and, in so doing, informs us what is the connection between the two words in question, or whether, indeed, there is any connection at all between them, any more than if they were two stones, thrown, by chance, into a contiguity or proximity. The words, *in any speech*, no more help us to move forward, and no more *indicate any object beyond themselves*, than can be said of the two banks of a river, with a bridge standing between them. Now, when we are walking on a bridge, WE (*i. e.* THE MIND) know that one bank has been passed, and that *another bank must follow*; but it is not the *passed bank* that indicates the bridge, nor the *bridge* that indicates the bank that is to come. The banks and bridges *indicate nothing*; they only *proclaim themselves*, respectively, as objects of our contemplation; and they leave it to OUR MIND to connect them, (*if we can*,) in idea, conformably to the connection that really exists between them."

Equally objectionable, it is conceived, is the phrase "vehicle of thought," applied to language, which *never did nor never can convey any thought.* Its office, in this respect, is simply to excite or suggest in another mind, another thought similar to the thought which it expresses. In short, speech, either read or heard, is merely a "path for thought to travel in, traced out in an otherwise markless void, which one man has trod down, and thus left signs that enable another man to follow him."

Before applying these preliminary remarks on the nature of signs to the special purposes and objects of language, it may be worth while to consider, a little more narrowly, the assumptions and principles which Mr F. has made the foundation of his system of philosophical grammar. It were injustice to his character, as an independent and original thinker, to imagine that he will not patiently listen to any reasonable objections, or that he is incapable of duly appreciating in others the same freedom in discussion which he himself has exercised. But, at all events, the questions at issue are too important and comprehensive to be determined by private authority, or without appeal to the common-sense-apprehensions of mankind, and general experience. Of the *intensity* of his sentiments, some idea may be formed from what he says in regard to the adoption and continued employment of one expression, against which he has pronounced a veto: "I can anticipate, says he, that fashion, supported by prejudice, may strain hard to retain the use of the phrase, 'instrument of thought,' which expression, like a cherished play-thing, will not willingly be thrown aside. But if the claims of reason, in modern logical speculations, should happily triumph over sound embodying error, I think no writer of eminence will, in future, deliberately stake his reputation to a use of this phrase; and if, in violation of reason, the fashion should still prevail, I observe, that the matter in question is not merely an innocent foppery in science, but it is an expression which involves and promulgates a very serious error in our conceptions of the nature both of language and of thought itself." What will be thought of the temerity of that man, who, immediately after having transcribed this passage, without being able to avail himself of such an eminence as removes him from the reach either of ridicule or serious reproof, and, who, besides, has shewn that he is no slave to fashion in opinion, deliberately and distinctly undertakes the defence of a phrase essentially synonymous with that which it prescribes, and, consequently, virtually and by implication, of the phrase itself?

In a brief essay, entitled "Some Thoughts on a Philosophical Language," printed in the Edinburgh Monthly Magazine and Review, so far back as 1810, the writer of these pages expressed himself, with a marked reference to the analogy contended for by Mr F., to the following effect. What Bishop Wilkins called a philosophical language, ought rather to be denominated a commercial one, its author intending it for a medium of communication betwixt persons who were ignorant of each others languages, and not as an *instrument of reasoning*, like *algebra*, by which, according to certain rules, we may attain to general conclusions respecting the objects of our thoughts. His system, then, however philosophical the principles on which it is founded, does not correspond to the thing intended by the expression a philosophical language. Algebra is certainly such, and does certainly accomplish, in one considerable branch of human knowledge, what may be accomplished in other branches of knowledge by a similar invention. It is of consequence to understand clearly what is meant by an instrument of reasoning. *The expression is undoubtedly metaphorical*, as in general are all those expressions which we employ in order to explain or treat of any of the operations or faculties of our minds. This one is borrowed particularly from what we are often necessitated to have recourse to, when engaged in working upon or modifying some piece of matter for the useful purposes of life. Our own unassisted powers are inadequate to effect what we have in view, as to break a stone or to lift a weight. In such cases we are taught by experience, founded at first, perhaps, on some accidental observation, to make use of some other piece of matter, as another stone, or a pole, in such a way as to augment the effects of our natural powers. The thing we use for this purpose is called an instrument; and very often, where our natural powers are of themselves quite sufficient to accomplish the end, we nevertheless employ instruments in order to facilitate labour, to save time, or for other reasons. Our natural powers may be insufficient, either in degree or in kind; or, though not insufficient, it may nevertheless be convenient to employ an instrument in aid of them. Something similar may be observed in the exertions of our reasoning faculty. But, not to follow out the analogy, it may be stated in general, that occasionally we carry on a process of reasoning without the intervention of any medium, *i. e.* in our thoughts or conceptions themselves; but more frequently we have recourse to an instrument. This is always the case where the conclusions we arrive at are of a general nature, *i. e.* respect the *genera* and *species* of things. The instruments we use in this case are what are commonly called *general terms*; nor, is it possible to carry on such a process of reasoning without the employment of such words. We may reason without using language, but then our conclusions will be particular; and this will be the case, when our reasoning is carried on by means of words which are restricted to individuals only. Where our conclusions are general, it is certain both that we have employed an instrument, and that *that instrument* is either a language or some equivalent invention, which *is a system of signs representative of the general properties or affections of the objects of our thoughts.* The use of words, or other signs, is essentially necessary in this case; but, though often very useful in order to save time, &c. is by no means essentially necessary in the other, where we reason concerning individuals or particulars only. Sometimes, it is true, we use a particular object as a sign, and reason about it so as to arrive at a conclusion applicable to all the other objects agreeing in nature or properties with that one; but this is no exception to what is stated as the rule by which the reasoning process is carried on in the case specified. Rather, indeed, it is an instance of the rule; for the individual object is made the representative of several objects, which it could not be if general terms were not used; and, in applying the conclusions so obtained to other individuals represented by that one, *we do no more in fact than recollect that they are so represented.* In some cases, we

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make inferences as to certain properties of bodies, &c. where these properties were not considered as included in the individual which we use as the representative of others. But neither is this reasoning by *analogy* any exception to the rule; on the contrary, it implies the use of general terms, and it may be probable, it is believed, that *analogical reasoning is impracticable without the medium of signs.* General terms, therefore, considered as a system subject to certain rules, may properly enough be called a philosophical language. But what is now contemplated under that name, is a *system of signs representative of the relations, connexions, dependencies, and, so to speak, the involutions and combinations of those general terms.* The invention of algebra is precisely such, and the success attendant on it ought to encourage to similar inventions in the other parts of human knowledge. To establish such a system, the philosophical principles of grammar must first be investigated; all the possible combinations of the parts of speech must be ascertained and classified; the logical rules by which we proceed in searching for and stating truths must be scientifically elucidated; the order and progress of our intellectual faculties, both in acquiring and communicating knowledge, must be understood, and so stated as to serve for a rule to be adhered to in the use of the system. All of this, with some little exception and difference, was accomplished in the science of numbers, previous to the invention of algebra. In a similar attempt, it would be advisable at first to confine one's attention to one species or mode of reasoning, as *analogy* or *induction*, or to one branch of knowledge, as *natural history* or *physics.*

Such were the writer's views at the date mentioned; since which time, with numberless interruptions, but a continual persuasion of their importance, and a hope of bringing them to bear on the interests of mankind, he has occasionally occupied himself in prosecuting and illustrating them. He is not ashamed to confess, that he thinks them substantially correct in principle and unexceptionable as to phraseology. The phrase "instrument of reasoning," or "instrument of thought," whether applied to algebra or common language, seems to him a highly useful and totally unobjectionable *metaphor*, to denote, according to a very fair definition of the word instrument, namely, "a tool used for any work or purpose,", or "the agent or mean of anything," that system of representatives by which the reasoning faculty, the thinking faculty, or, to use the most general term, the mind, expresses, designates, records, communicates, the ideas, notions, or conceptions, on which it is variously exercised. Nay, farther, he conceives that language may be held to be an instrument of reasoning or thought, in a sense if possible still higher, namely, of such a kind, that, by means of it, according to certain rules, conclusions may be obtained which were not originally known, and which, therefore, could not have been intentionally expressed. That this is the case in the language of algebra appears perfectly demonstrable, and, it is imagined, will not be disputed by any man who understands what is accomplished by bringing an unknown quantity to one side of an equation and all the known quantities to the other. Mr F. himself admits, that the sign of operation or action in this science is both a *link* and a *bridge* of logical connection between the two signs of quantities which it divides. Now, not to speak of the variety or of the capability of combination on the part of these links, or the possibility of two or more bridges being connected, it will be very difficult to prove that there is either foppery or dangerous heresy in the application of the term instrument, defined as above, to even one of them; and equally so to explain the nature and use of a bridge, without taking into account the circumstance of its being a mean by or along which we pass from one bank to another.

An instrument of thought.

A similar remark might be made on Mr F.'s favourite substitutes for an instrument and a vehicle, namely, a road or foot-path, and the stepping-stones thereof. These, indeed, are not instruments precisely in the same sense in which a razor, a guitar, or a pair of snuffers are held to be instruments; but they undoubtedly both serve to indicate and ascertain an interposed distance, and at the same time guide us, if not, from their superiority to the unbeaten and perhaps impossible ground on either side of them, *materially aid us*, in getting over that distance. The very term *connection*, moreover, used in reference to logic or mathematics, as Mr F. has repeatedly used it when speaking of the category of relation and the signs employed both in ordinary and algebraic notation, just as much implies an instrument as the same term when applied to a *rod* or *chain*, by which two distant objects are in a certain manner or to a certain degree united together. So far as to the instrumentality, even in the highest sense, of the language of algebra. There needs only a short quotation from Mr F.'s own work to prove, that, in the same sense, the signs of operation in ordinary language, and consequently ordinary language itself, may be justly favoured with that appellation, and held capable, as an instrument, of aiding our natural powers in the discovery or acquisition of truth. "The identicalness of the two systems of notation must be obvious to the mathematician at least. For, although algebraical analysis is WRITTEN in *symbols*, it is READ in *words*, and the theorems of geometry are BOTH *read* and *written* in ordinary language, both which facts must have been impossible, if the signs of operations in ordinary language were not capable of admitting an interpretation as perfectly significant of the relations to be expressed in the sciences and geometry as can be said of the symbols employed in those sciences." In the sentence preceding this quotation, he speaks of his intending merely to intimate the matter in question, with a view to enable a reader to form *some immediate general conception* of what degree of advancement may be expected, or rather which must result, in the science of grammar, if he should succeed in establishing one of his positions. Now, what is this but using language as an instrument of thought in a double sense,—first, as the agent by which he himself operates, or endeavours to operate on his reader; and, secondly, as the mean by which the reader is to form some immediate general conception, that is, to think in a particular way, and so as to come to a particular result. Strictly speaking, the expression by which Mr F.

Relation and Relativeness.

seems to imagine he gets rid of the errors couched under the one he reprobates, is not at all more appropriate and free from pernicious ambiguity and evil consequences. "The real instruments of thought are the faculties of our mind, actuated by our will." He adds, by way of explanation, "it is a faculty of our mind that steps from word to word, and, in so doing, informs us what is the connection between the two words in question." Now, admitting that it is a faculty of the mind, and not the mind itself which steps from word to word, and which, by this stepping, informs *us*, (what *us?*) is it not clear, that the words so stepped are the means or instruments, be they links, bridges, roads, or only stepping-stones in roads, by which the faculty goes from one spot or place to another? Nay, does not Mr Fearn assign instrumentality to language, when, having denied that it *conveys* thought, he says, "it can only *excite* or *suggest* ANOTHER *thought* in another mind SIMILAR to the thought which it expresses?" Is there less agency in exciting than in conveying; or, is there anything in the nature of *similarity* of thought, more than there is in that of *identity* of thought, which destroys the operativeness or efficiency of what suggests, that is, hints or intimates thought? On the whole, until he has answered these and several other questions which might be put, it is imagined to be quite reasonable to adhere to a phrase, which, when carefully investigated, will be found to have something else than mere fashion to recommend it. These strictures will not be thought unnecessary or unprofitable, if they point out the difficulty, it may almost be said, the impossibility, of treating or speaking of the intellectual operations in language which does not partake of imperfection and fallacy arising from the change of use to which it has been subjected. Perhaps the remark of Hobbes, no less profound than it is witty, "Words are the counters of wise men, and the money of fools," embodies all that is really good in Mr F.'s speculations on this part of his subject, as well as all for which it is worth while to contend against what is not good in them. But, in both cases,—those of the wise men and fools,—it would seem words are, to all intents and purposes, instruments. Indeed, such is the constitution of our nature, that we cannot prosecute intellectual intercourse, at least to any considerable extent, with our fellow-creatures, unless we have recourse to them; and on the supposition that there is a peculiar faculty in mankind, allotted to the acquisition and the employment of language, as some recent philosophers affirm, it would be easy to shew, that even Mr F.'s view, in regard to the real instruments of thought, sanctions the phrase which he has so strenuously condemned.

On the subject of his structure of relation, we do not hesitate to say, we think Mr F.'s views are perfectly correct; and that he has the merit of distinctly explaining the nature of relatives and relations, and of pointing out the error of those writers, some of the most eminent in metaphysical sciences, who have confounded them together. *Relatives* are two things, having a certain *relation*, and that relation which is implied by the words *between* is neither one relative nor the other, but a third, or middle thing distinct from both, in regard to which they are relatives, or constitute relatives and correlatives. We mean this relation, or third thing, when we apply the word *like*, or *equal* to two things, whatever may be the idea expressed thereby, or the species of likeness intended. The same remark applies to all other terms used as, we say, in relation to different objects. In short, every two things have a real partition, difference, or division between them; and it is altogether in virtue of this partition that one of them is a relative to the other. If there were no difference, partition, or, so to speak, *relation of severality*, they would not be two things, but one thing. It follows, that relations are positive things; and it is not incorrect to say, that their existence is the necessary consequence of the co-existence of the things of which they are the relations, or that they are efficiently caused by that co-existence. But it is quite certain that relations themselves may become relatives, and, in reality, are such, to each of the two things between which they are the relations. Hence, then, all relation, in the logical sense of the word, must be between three things, that is, must be a combination of two primary relatives, and a consequent or produced relation, which becomes a third relative between them. Now, all relations may be considered, what in reality they are, as *logical actions between related subjects*, or *logical causes of these subjects being relatives;* and, accordingly, as formerly stated, this relativeness of things and the relations between things constitute the foundation and the object both of universal logic and of language.

The Nature and Use of Verbs.

We now proceed to the application of the principles which have been explained. It would seem, according to Mr F. that nouns are prior, as to grammatical use, to verbs, precisely, he would say, as things connected must precede the thing which connects them, or as the two banks of a river existed before the bridge which is interposed between them. For several reasons, nevertheless, and specially because of the greater obscurity which pervades their nature, he gives precedence, in respect of arrangement and examination, to verbs. To us the claims of verbs seem still more urgent, because, notwithstanding all he has said, and for the reason implied in the last sentence of the preceding paragraph, we adhere to the opinion, that, so far as the grammar of natural language is concerned, the signs of actions, that is, substantially, the prototypes of verbs, were first had recourse to in order to communicate to others what passed in the mind. The only plausible or forcible objection which can be urged against this supposition is, that, before actions of any kind could have been conceived, or signs of them given, there must have been *substantive natures*, of which these actions were the operations, and others to which they bore reference either as cause or effect. Our answer is certainly hypothetical, and we offer it as such, but not without a notion that it is in all probability correct and well founded,—namely, that the knowledge and belief of our existence, however originally excited, or on whatever portion of our organization dependent, and, therefore, the ideas of objects, are consequent on and subsequent to the consciousness of active power; that this consciousness indicates itself by the signs of natural language; and that these are virtually *verbs.* If Mr

F. shall insist, that, even on this ground, these primary verbs are links or bridges of connection between the conscious being and the substantive natures around him, or generally space and time, and are, therefore, more especially when they get appropriate *names*, merely nouns, we believe we must yield;—only, in this case, we must be allowed to contend, that naturally there are no verbs, or that nouns and verbs are convertible, and that the controversy in regard to precedence between them is interminable, and probably altogether useless. With this proviso and explanation, and we know that Mr F. can have no disinclination to admit them, not as advanced for the sake of our honour, but as, on their own account, entitled to respect, we are quite ready to take him for our guide in the discussion of the nature and import of the verb.

The fundamental principle of his system, that in which he differs from all preceding authors, is simple, but most comprehensive and sufficient, namely, the verb is a grammatical link of connection, or a grammatical copula, between a nominative and an accusative noun; and, holding this to be essentially and invariably true, it is equally denied that there are any verbs which do not admit an accusative case, and that those verbs which do admit an accusative are not links of grammatical connection between their nominative and the accusative; in other words, contrary to the current doctrine of grammarians, but, in accordance with natural reason, it is contended that verbs are *connectives* and not *attributives*. Dr Lowth, indeed, in distinguishing between an active and a passive verb, says the former "expresses an action, and necessarily implies an agent and an object acted upon," and the latter "expresses a passion, and necessarily implies an object and an agent by which it is acted upon," from which it might be imagined that he clearly admitted a verb to be a link of grammatical connection between an agent and its object or co-agent. But though, from the brevity and nature of his work, it is not practicable to determine his real meaning, it is fairly presumable that he entertained no such correct idea; and Mr Harris, again, between whom and that author there is known to be a close concurrence of sentiment in regard to grammar, has explicitly proved his rejection of it by treating of verbs under the title of attributives. He sometimes, it is allowed, speaks in such a manner as would lead one to conclude, that he really considered verbs as connectives; for he speaks of every *energy* not only requiring an *energiser*, but, being necessarily conversant about some subject, and says every energy is necessarily situate between two substantives, an energiser which is active, and a subject (object) which is passive;" but his language elsewhere, and his reasoning throughout, give unequivocal evidence that he imagined the signification of an accusative, in the case of active verbs, is merely useful or requisite for "the information of a hearer, to let him know what, or who, is the particular object of an action," and that it is not at all necessary, "in the nature of language, that a verb should have an accusative case to support its farther end, upon the same principle that a bridge must have an off-bank to support its farther end." It is unnecessary to have recourse to other authorities.

The notion, that every verb must have an accusative as well as a nominative case, may be thus supported. A noun, considered by itself or absolutely, is not, properly speaking, what grammarians style a PART OF SPEECH, that is, any special part, but simply a homogeneal element of the whole mass of speech; and in this respect every word in language, taken in the abstract, or not viewed in connection with other words, is a *noun*. "It is," says Mr F. very forcibly, "no part of speech, technically so called; but is merely a mass of *lingual material*, shaped and adapted to be employed as a part of speech; just as any mass of stone in the quarry is not the key-stone, or any other stone, of an arch or building, but is merely cut and adapted to serve as a key-stone, or any other stone, in an arch or building." But when any word enters or is taken into composition, and made to serve for the sign of a related subject, that is to say, for an agent, it then becomes a special part of speech, or what is called a noun substantive. As, then, a noun substantive is the sign of an agent or relative subject, so is a verb the sign of an action or relation between any two relative subjects, and connects some two co-agents together. Accordingly, it requires both a nominative and an accusative, as it is impossible for a related subject or agent to exist and carry on some action or relation without the aid or presence of any co-agent or correlative. The fundamental logical maxim, that "relatives must begin together, exist together, and cease together," is equally true in grammar, and in the nature of things as contemplated by us. Any subject in the universe, abstractedly considered, is only a homogeneal mass, and, though it may be signified by a noun, "is not an object of language considered as a connected series of signs representing a connected series of ideas;" but, when viewed *in relation*, it becomes a component part of the universe, and only then is "an object of language considered as a system of special signs." All the subjects of the universe, then, so far as grammar is concerned, may be distributed into three grand classes, THINGS ABSOLUTE IN THEMSELVES; THINGS AS RELATIVE; and the RELATIONS BETWEEN EVERY TWO RELATIVE THINGS. How intimately connected this distribution is with the principles of philosophical logic, may be easily seen from comparing it with what was hinted on that subject under the article LANGUAGE.

Assuming that every verb, being the sign of some relation between two related subjects, must have both a nominative and an accusative noun, the doctrine of grammarians respecting what are called *neuter verbs* must appear exceedingly absurd. "A neuter verb," says Dr Lowth, "expresses being, or a state of being, when the agent and the object acted on coincide, and the event is neither action nor passion, but something between both; as, "I sleep, I walk." Here a state of being is imagined, of which the agent and its object, that is, the agent and the co-agent, coincide, which is quite fallacious in a physical as well as in a logical or grammatical sense; for, in the cases alluded to, neither the sleeper nor the walker is his own object, inasmuch as he must sleep or walk *at* *some time*, or *upon some thing*, which time or thing is really, though only understood or implied, the objective case to the verb; and a similar remark may be made on every other example of so called neuter verbs. Farther, Lowth's definition supposes agency, and at the same time an event which is neither action nor passion, but something between both,—a something, however, of which it will be exceedingly difficult, if not entirely impossible, to form any idea. Even in the case of what are denominated *reflex* verbs, as, when it is said, "he respects himself," there is really no coincidence between agent and co-agent, however it may be supposed to be expressed or understood; on the contrary, it is implied by a necessary logical fiction, and, according to the axiom, "nothing can be related to itself," that the subject or agent is divided or duplicated into two logical subjects or agents. In regard to verbs which take an accusative case "through the medium of a preposition," and which Dr Campbell has styled *compound active verbs*, it is remarked, that, though the circumstance of taking an accusative case does not, according to grammarians, constitute any verb a copula between its nominative and that case, it can be distinctly shewn that *every major verb*, in logical strictness, requires what is called a preposition between it and the annexed noun; that the preposition, if not expressed, is always implied, so that the sentence is elliptical; but that, notwithstanding, there is no instance in language of such a thing as a compound verb, and that, in all those expressions in which it is supposed to occur, the verb is perfectly simple, as it is in every other case. In short, the simplicity of verbs depends on a principle of perpetual authority, and which admits of no deviation, namely, it is impossible there can be more than one simple link of relation between any two related subjects, *taken in any one view of them*; from which it naturally follows, that it is impossible for any verb, considered as the sign of such relation, to be double or compound between any two nouns in a sentence. From this principle, too, there results a curious peculiarity in the structure of language, to which an allusion has already been made, but which, from its high importance, demands distinct enunciation, namely, "every verb, in a sentence in which more verbs than one intervene between any two primary nouns substantive, whether it be a principal verb, an auxiliary verb, or what is called a preposition, must serve, in that sentence, alternately as verb and as noun." This peculiarity is actually recognized by grammarians, when it is admitted that what is called *the infinitive mood* sometimes serves the alternate office of noun and verb, and, again, when *verbals in -ing* serve as a noun, and at the same time have a *regimen like a verb*; but the principle on which it depends, grounded in reason as it is, and a modification of the fundamental axiom of grammar, has not been discerned by them so as to constitute a general rule.

There is one verb, the verb *substantive*, which presents an apparent exception to the ascertained law regarding the nature of verbs, and which, consequently, demands special examination. It has generally been thought anomalous, and to differ from all other signs belonging to this part of speech, namely, as a *copula*, but not a copula of a nominative with an accusative noun. This notion of its constitution has arisen from the circumstance of its accusative not being very obvious. A little attention will discover it, and exhibit the signification of the substantive verb to be very different from what has been usually assigned it. Vulgarly, when a thing is asserted simply to *exist*, it is imagined to *exist itself alone*, that is, to have no connection with any other thing; and, in accordance with this supposition, the word *exist* is not conceived to be the sign of a species of action between two subjects. Grammarians have sanctioned this erroneous assumption. But, in place of it, let us only reflect that every individual subject in the universe, of which existence can be predicated, inasmuch as it occupies both space and time, not to speak of other beings or subjects, necessarily has *relativeness*, and, therefore, maintains its own side or end of an action or relation, and we must come to the conclusion, that the sign which denotes this action or relation, that is to say, the verb substantive, is essentially the same as every other sign of action or relation. In reality, the proper definition of existence implies and comprehends the *occupation* of time and space, which occupation is in strict logic a species of action. If, then, we disregard the consideration of time, we may hold SPACE to be the UNIVERSAL ACCUSATIVE NOUN to the VERB SUBSTANTIVE. A singularly striking confirmation of this *a priori* reasoning as to the nature of this verb, which Mr F. hazarded some years ago, has been furnished since the period of its occurring to him, in Dr Murray's posthumous work, and must not be passed over. After stating, and, by examples, illustrating the position, that "all verbs which express a *fixed, immoveable*, or *settled state*, arise from verbs which signified *the contrary*," he proceeds to the conclusion, that, by the original construction of language *all neuter verbs are active*. "I stand," says he, "I sit, I am, may be expressive of states, unconnected in idea with action; but I stand literally signified in old times, IC STAG-ENDA-A, *I am setting my feet*, not I remain in the state of having set them; IC STIG-STA, I perform the act of sitting, or I sit down voluntarily and actively. IC AM, for IC SIGM or SUM, denoted I move, I actively live in a place, a word analogous to IC BIG, I dwell, I cultivate, I stir, I lie." Clearly, they who used this language did not think the verb substantive signified a quiescent state, but, on the contrary, classed I AM, I BE, with those verbs which any way connect subjects with space. It is probably deducible from the same principle, that, as every action connecting a subject with space is a modification of *the action of existing*, so every verb expressing such action is a modification of the verb substantive. The etymological acuteness of Dr Murray was so far successful in the discovery, that all verbs, including the verb substantive, were naturally active; and it is deeply to be regretted, that, having made it, he should almost instantaneously have abandoned the light which broke in upon him, and, neglecting the necessary principles of reason, should have considered as improvements in language those deviations from its fundamental principles which have resulted in the supposed conversion of the verb substantive into a word expressive of a *state* only, and not an *action*, the imaginary provision for designating a *passive state*, and the invention of a *new voice*, called the *middle, reciprocal*, or *proper*. He has been most unfortunate, as might have been expected, in his attempt to illustrate this voice, by restoring, as he thinks, the Visigothic passive into such expressions as "I lay on, or, to myself," "I speak to myself," "I cling to myself," understanding thereby not any real actions, but what are called *states*, or *intransitive acts*; and not adverting to the decisive fact, that we make use of the same expression to signify, generally, I lay, I speak, or I cling, and *I lay on myself, I speak to myself*, or *I cling to myself*, when real specific actions *are* intended, of which *myself* is the proper grammatical object or accusative.

The general conclusion from the analysis hitherto carried on, is most important. ALL VERBS WHATEVER ARE OF ONE SAME GENERAL NATURE; and, consequently, the pretended or alleged differences in *sorts of verbs* have no foundation in reason. It is, in one sense, subsidiary to this conclusion, but, in another, of primary importance, that as verbs are the signs of actions, and as *action*, considered in itself, and distinguished from *energy*, cannot be *active*, but is merely a MEETING, OR A CONNECTION OF CONTIGUITY between some two things, and not an energy or emanation from a single subject, the distinction of verbs into active or transitive and passive is unwarrantable, and, universally, verbs are, and must be neutral, or rather cannot possess either activity or passivity, which belong to nouns only. It is equally clear, from the same principles, that no word whatever, considered as a mere word by itself, is or can be a verb of any sort; that words become verbs simply and solely because of their expressing or being the signs of actions or relations between two related or relative things, constituting what are usually called the nominative and accusative or objective cases; that any word may become a verb, which is so used as to be the sign of a relation between two related subjects; but that the name of an action, when taken alone, is no more a verb than the name of any thing or quality is; farther, that a verb is never the sign of more than one simple object, namely, that relation or action which exists between two related subjects; consequently, that a compound verb is an impossible thing, although simple verbs may be, and often are, expressed or used consecutively, and as it were in combination,—in which case, however, each of them must be understood as operating or standing alternately in the office of noun and verb. Keeping in view, then, the simplicity of the nature and the use of the verb, we might now advantageously enter on the consideration of what are called the *tenses*, the *modes* or *moods*, and the *voices* of verbs. But there are two or three topics which require previous attention, in order to the confirmation or illustration of some of the positions and principles already advanced.

It was the opinion of Mr Tooke, that though a *verb* is, as he thought every word must be, a *noun*, it is also *something more*, and that the title of verb was given to it on account of that *something more*. But, proceeding, immediately after stating this fact, to treat of the simple *verb adjectived*, and the different *adjectived moods* and *tenses* of the verb, he has left entirely unexplained what he meant by the naked simple *verb unadjectived*, and, equally so, what he meant by the *something* which the naked verb, that is, the verb without any mood, tense, number, person, and gender, signifies, over and above what is signified by the mere noun. In other words, he has not shewn what that circumstance is, which, being added to the definition of a noun, constitutes the verb: but, after having given several definitions of a verb, such as "dictio variabilis per modos," "quod agere, pati, vel esse, significat," "nota rei sub tempore," "an assertion," "un mot declinable indeterminatif," all of which he lumps together under the title of "trash," he closes his work with rather a faint hope than a strong expectation of being allowed time to resume his labours, and discuss the subject. The essence of the verb, then, was left by him in the darkness in which he found it, and from which, probably, he did not feel himself able to extricate it,—not by any means because he was destitute of the talents or ingenuity necessary for the task, but because they were not directed so as to prove successful. Now, the differential circumstance, which, conjoined with the noun, constitutes the verb, has already been indicated, namely, in the fact of *the insertion or interposition of a noun of action between two other nouns*; and this insertion or interposition is simply a sign of assertion, that is, a sign of a voluntary act of the mind or of our thoughts, of which act the grammatical principle, or a representative system, such as that of language, can afford merely an external type or symbol. A verb, accordingly, so far from being simply *an assertion*, as there is some reason to believe Mr Tooke, or *an assertion and an attribute*, as Mr Harris conceived it to be, consists of two different elements, namely, a noun, and insertion or associated position between two other nouns, that noun itself being essentially or virtually a noun of action, and that insertion or interposition being the sign of the mind's *asserting* or *affirming*. In one passage in his work, (Vol. II. p. 452, 4to edition,) Mr Tooke, it is true, notwithstanding his admission elsewhere, denies one of the elements in question; but here, which is curious enough, though he both contradicts himself, and errs egregiously as to the essence of the verb, he nevertheless approaches very nearly to a right conception of a fundamental principle. His words, accordingly, richly merit quotation, and will be found of some consequence hereafter. "The verb does not denote *time*; nor does it imply any *assertion*. No single word can. Till one thing can be found to be a couple, one single word cannot make an *assertion* or *adfirmation*; for there is *joining* in that operation, and there can be no joining of one thing."—He only required, it would seem from this paragraph, a knowledge or clear perception of two circumstances, to have been put quite in the right path as to the nature of verbs, and, consequently, as to a very large portion of the structure of language. These two circumstances are, first, that a verb is not a word or part of speech, that is, in its whole

Abstract General Terms.

essence or purity, and exclusively of its associated position, but a word, that is the sign of an action, inserted or associated between two other words; and, 2dly, in direct opposition to one of his own doctrines, which assumes the "absoluteness of words in their grammatical character, and their never changing their part of speech in any situation whatever," that ASSOCIATED POSITION, the external sign of assertion, which is a constituent element of the verb, is one of the most influential principles in language, the GENERAL CONVERTING CAUSE of verbs and adverbs, the source or reason of the alternation of a verb in a sentence, of the transmutation of substantives into adjectives, and adjectives into substantives, in short, "almost every thing in the mechanism of language." The great error, or positive blindness as to this particular, namely, the fact and the immense importance of associated position, considered as the type or symbol of the mind's asserting or affirming, undoubtedly had its origin in his determined metaphysical scepticism regarding *operations of the mind in general*, and his consequent denial that *affirming and denying are operations of the mind.* But, admitting that they are operations of the mind, or, as it seems to be decidedly proved, not only by his own etymological speculations, but by the more extensive researches of Dr Murray, that *negation consists simply in asserting dissent from a proposition*, resolving them into one operation, or act of the mind, that of assertion, and taking associated position, whether accomplished by the hand or the mouth, for the external sign of that act, we shall easily perceive, that the conversion of a noun into a verb depends upon the volition of the mind, and is effected by appositing it between two other nouns; and that not only verbs, but likewise *adjectives*, involve a sign of the mind's asserting, are not mere words or names of things apposited to other names of things, and, consequently, like verbs, are composed of two different elements.

The next preliminary matter to be settled is of great interest to the metaphysician, and, at the same time, enters very seriously into any question regarding the structure and uses of language, namely, the view that is to be taken of what are usually called ABSTRACT GENERAL TERMS. The bulk of words in a language is usually imagined by logicians and grammarians to consist of those terms; and it is by a hypothetical conversion into them, that at least one class of philosophers endeavours to get rid of all the difficulties supposed to be involved in the doctrine of the composition and the comparison of ideas. Now, if by *term* be intended, as Mr Tooke and other writers seem to have intended, an abstract noun and substantive, it can be made appear, on the principles already laid down, that there is no such thing in language. For, first, it has been shewn that a noun, considered by itself, is not any such element of language as grammarians denominate a part of speech; hence, that such words, as are generally taken for abstract terms, are not nouns and substantives. It is a component part of this proposition, that the words in a lexicon are not language, but merely materials adapted to the use of, or to be employed in, language, precisely as the letters in the box of the compositor are adapted to form any portion of speech when set up by him in a particular way. They do not affirm or deny any thing, and, in this, their insular state, are without relativeness to any thing in the world. Even the addition of adjectives alone, to such words, does not make them nouns and substantives, nor any way change their character, except by rendering them more complex, so that, in the sense of the logicians, they could be predicated of fewer individuals than were comprehended under the simpler terms,—as, for example, *white man, large animal.* And, secondly, it is only when taken into composition, by means of some numeral or distributive definitive which has the power of an individuating principle, that they enter into language as signs of related subjects, and, in the very act of so entering, become nouns-substantives, and to all intents and purposes are CONCRETE TERMS, which all nouns-substantives in language necessarily must be. The expression, "man is mortal," may be resolved into "all men are mortal;" and the word man, by virtue of its entering into composition with an individuating element, becomes a concrete term; whereas, by itself, it really had no meaning, though it possessed the power, according to conventional arrangement, of being used as a sign to denote a particular being. The notion of its being the sign of a GENERAL MAN, is obviously absurd; for, as the author of the Procedure, &c. of Human Understanding, says, "these general abstract ideas shall, in the modern refined method of forming them, prove the strongest and most inconsistent monsters in the world. Thus the general abstract idea of man shall not be of a black or white, short or tall, thick or slender man; but shall be *all* these, and *none* of them at the same time." The doctrine, then, maintained by Tooke and others, that *composition* is not in ideas, but only in terms, is erroneous, and, indeed, might be concluded to be so for another reason,—as the assumption seems to be exceedingly fallacious and unsatisfactory, that words should have composition, and yet the things of which they are the signs should not have composition. Words, it must again be stated, are precisely as the shadows of our thoughts; and, hence, the structure or composition of language strictly resembles the structure or composition of our thoughts. Thus, then, the parts of speech, in any portion of language, will be found to be disposed similarly to the relative variation of thoughts thereby expressed; and thus the assertions of Tooke, that "the business of the mind, as far as it concerns language, extends no farther than to receive impressions, that is, to have sensations or feelings;" and, again, that "what are called the operations of the mind, are only the operations of language," are contrary to truth and sound reasoning.

Action as a logical subject.

There is only another preliminary point to be settled, and it is of grammatical consequence, as the fact concerning the universal neutrality of verbs depends on it,—that is, the nature of action viewed as a logical subject. On this point, a good deal of misconception seems to have prevailed, and probably has had its origin in the circumstance of grammarians and philosophers having usually or frequently contemplated action rather in its *moral* aspect than its *physical.* In the former, generally speaking, it is of chief importance to distinguish and particularize the voluntary

The Objects of Words.

agent, as the *quality* of the action must be ascribed to him alone; but, proceeding too closely on this idea, and the observation to which it leads, the agency, in the case of physical action, has been ascribed exclusively to the *subject that moves to another,* and is, consequently, supposed to be an *assailant.* Accordingly, either the voluntary, as the leading co-agent, has been imagined to be the SOLE-AGENT, and, on the other hand, the following co-agent is considered simply as a PATIENT. But, in opposition to this view, it may be asserted, as almost obviously true, that before an action, considered as distinct from energy, can have an existence, the patient, so called, must co-operate with what is called the agent, and, consequently, in a strict logical sense, is as much an agent or cause. This is the very principle on which the nature of the verb is founded, and therefore the verb is held to be the sign of an action or link of connection between two co-agents; and action, again, is the thing which makes two *relative* subjects of otherwise *absolute* subjects. Philosophical grammar, it seems, then, is founded on the logical nature of action or relation; and verbs, the signs of action or relation, must conform to the necessary structure of the category of relation, independently of any partial view of the *moral* qualities of action, which, in reality, verbs, simply as such, are not formed to represent.

But, though verbs are constructed to signify actions in their complete nature only and not as *moral,* language, nevertheless, furnishes us with the means of signifying a moral or any other partial view of action; and to these means, it is now proper for us to advert. Here, then, as formerly hinted, it is to be noticed, that the sole purpose of language, infinite as the number of things to which it is applied may be, is to signify relative objects, and the relations between them. Now, the objects of speech are divisible into three great classes: 1. Those of actions themselves, in the expression of which we must signify both the co-agents; 2. The peculiar states of the leading co-agents of actions, in signifying which we may not introduce any expression of the states of the following co-agents, or, in other words, we may signify only one of the co-agents; and, 3. The peculiar states of the following co-agents of actions, which, in like, manner, we may express without signifying the leading co-agent. With the exception of LIMITED SILENCE, of which, considered as an element of speech, Mr F. proposes to treat in the second volume of his work, these three are all the varieties of object which it is possible for language to express, and constitute the "different sorts of things," or "different sorts of ideas," into which philosophers and grammarians have endeavoured to divide the objects or prototypes of words. It now remains to be shewn, by what signs these general objects can be represented. First, then, only one of the three, namely, action, taken with its co-agents, is a natural object, and, as such, can exist in that form which is signified by words; and, as frequently stated, the sign of it is the verb. The two other objects may be called artificial, because, as it were, formed by the mind abstracting, or in idea parting off a certain portion of the natural object. Thus, we can divide this natural object, namely action, with its two co-agents, into departments, and contemplate either of the co-agents as being in a certain state with respect to the action, without taking into account either the other co-agent or a complete view of the action.

Adverbs as Signs of Words.

Now, the words used to denote these departments are necessarily different from verbs, in construction and use, though frequently confounded with them, and ought to have different denominations. Here the principle of *associated position* will help us. They are evidently abbreviated signs of several words, and become so by reason of that principle, on the application and operation of which, it would seem, almost any word, whether it be verb, preposition, adjective, or, so called substantive, may express either a leading or a following co-agent, with respect to any action. From one of their supposed uses, such words have been styled *adverbs*; and thus, on the principle of conversion, we are able to signify the peculiar state of any co-agent, whether leading or following; and by the sign employed, contradistinguish either of them, when viewed by itself, from the same when viewed together with the action and the other co-agent. Hence, then, if the words converted be, for example, the names of actions, such words apposited to nominatives, but without having accusative nouns, *on the other side*, become much more than verbs, which adverbs really are, as involving, at least, the import of both a preposition so called, and an objective noun; and hence, too, every one of the so-called verbs, as arranged in our grammars, in what is denominated its *paradigm,* being a name of action annexed to a nominative, but having no accusative noun, although not a verb, according to the nature of the verb already explained, is a legitimate adverb or abbreviation, and represents a so-called preposition, and a noun in the objective case, with its article taken together. In short, keeping close to the generic structure of relatives and relations, which is never once violated, every conjugated expression of a so-called verb, thus exhibited, is an abbreviation of a complete speech or sentence, consisting of a nominative, a verb, and an accusative. From which it follows, that every adverb is a sign, not of any natural objects, but of *words only*,—that is, an immediate sign, not of a thought, or thoughts, but of a parcel of signs; and it is, consequently, an artificial part of a speech in a twofold sense, namely, as it is a sign of signs, and as the abstracted parcel of objects signified by any one of the signs cannot exist in nature separate from an action and a following co-agent. From this grammatical mechanism of adverbs, it is deducible, that any one of the essential parts of speech being found out of its natural position, associated with other words, is used adverbially; that the adverb, though not an essential part of speech, is almost necessary, and is highly useful; and that an adverb can agree with a noun, as a name of action, when annexed to a noun, becomes an adverb to that noun. Connected with these inferences, is the highly curious and important fact, that, as the verb substantive has no office, more than any other

Supposed Participles.

verb, to enable a so-called participle to assert, and though assertion or affirmation is effected in the so-called participial form, a so-called participle, annexed to a nominative only, becomes an adverb; from which, and other reasoning, it is manifest, that the participle of grammarians, that is, "a part of speech derived from a verb of the nature of its primitive so as to denote action, being, or suffering, and that of an adjective in agreeing with a noun, but differing from a verb, in not asserting," is in fact a nonentity. If it be a mere noun of action, it is consequently no participle; if interposed between two nouns, it is a verb; and if annexed to one noun only, it is an adverb. It cannot, therefore, be derived from a verb. Again, that it is not of the nature of an adjective has been shewn in the circumstance of a so-called participle becoming an adverb when annexed to a noun: and, with respect to the last part of its definition, it has also been shewn that such a word, when placed between two nouns substantive, *does assert*, or, so to say, when thus interposed, it exhibits the pure essential form of the verb itself, it being always understood that that form can exist only so long as it is interposed between two substantive nouns. It is a singular confirmation of this last remark, that, in the time of Chaucer, these so called participles were identical with the so-called infinitive mode of English verbs. Still, however, it must be recollected, that the office of assertion never is or can be performed by any one word whatever, asserting, whether it be of action or quality, being effected solely by the juxta-position of two words; and that the substantive verb IS, though like every other verb it denotes connection, denotes, not the connection of a subject with its predicate, but of a subject with an objective case—namely, the primary universal accusative, SPACE OR TIME, with which every subject must be supposed connected in the action of existing; and, consequently, that, in place of asserting some adjective act, it has merely the office of coupling a subject with space or with time, which is essential previously to being engaged in any adjective act. In the elliptical examples, therefore, of asserting in the participial form, where the substantive verb is not expressed, as in the idiomatic phrases abundant in the Hindostanee and Malayan tongues, as well as in Hebrew, "I coming," "I going," "I who," "I not eloquent," Mr F. thinks it is invariably implied and to be understood; juxta-position, though effectual in asserting, as already stated, not supplying, as has been supposed, the place of the substantive verb. In a like case, however, Mr F. is apparently opposed in a most respectable quarter, and the circumstance is worthy of his attention. "It may appear an odd peculiarity in the Gælic, says Dr Stewart, that in many of the most common phrases, a proposition or question should be expressed without the least trace of a verb. It can hardly be said that the substantive verb is *understood*, for then there would be no impropriety in expressing it. But the fact is, that it would be completely contrary to the idiom and usage of the language to introduce a substantive verb in these phrases." Dr S. admits, nevertheless, that in corresponding instances, to be met with in Hebrew, Greek, Latin, and English, for they are to be met with in all of them, "the substantive verb might have been expressed, if with less elegance, yet without grammatical impropriety; and he says that, "what has been frequently done in other languages, seems, in Gælic, to have been adopted, in certain phrases, as an invariable mode of speech." To proceed. This office of the substantive verb, it may be noticed in passing, explains what all along seems anomalous in common grammar, namely, that "it has always the same case after it that it has before it," so that, it seems, a verb is absurdly placed between two nominative cases; whereas, in reality, the second nominative, in such case, is the nominative not to the verb substantive, but invariably to some adjective verb expressed or understood. It only remains to be said farther in regard to adverbs, that, considered as abbreviated signs of plurals or strings of words, they are capable of being divided into different classes; but into the enumeration and arrangement of them, it is unnecessary to enter in this place. We now proceed to consider certain supposed peculiarities of the verb; and, first, as to TENSE OR TIME.

Tense or Time.

Holding it impossible to signify either future or past actions, directly and by a single logical term, Mr F. conceives that signs must be had recourse to which answer the purpose of exciting the conjecture that such is intended or implied; and, rejecting what are usually called verbs, but which are merely nouns of action with terminational inflections, the expedient adopted in several languages, he confines his view entirely to the genius of our own tongue, in which the operation of expressing the time of action, especially future action, is performed or attempted to be performed very philosophically. Now, here, it is certain, the action, whatever it may be, which the original or chief verb (always, of course, interposed between the nouns expressing the relative subjects) denotes, must be expressed as presently existing; and, precisely on the same principle, the verbs called *auxiliary verbs*, as *may*, *can*, *shall*, and *will*, are signs of actions presently existing. The only reason, therefore, discoverable in the nature of the word, why such auxiliary verbs indicate the *futurity* of the action denoted by the principal verb, is, that the actions which they express are actions of *choice*, *knowledge*, *duty*, or *volition*, respecting the action that is to happen; and, consequently, such auxiliary verbs must precede the original or chief verb. Thus, then, future action is expressed in our language in present time, and, it is believed, it can be expressed in no other manner than by means of such signs of present accessary actions. From analogy it might be presumed, that the like means would serve to denote past action; but here we find that the accessary sign, in place of being an auxiliary verb, so called, is a certain terminal change of the principal verb itself, as "*love* (present) "LOVED" (past), the termination -ED or -D, being generally supposed to be a sign or word distinct *from the form of the present*. What that termination actually is, and what its real import ought to be, are questions which have occasioned some difficulty to etymologists. Tooke and others conceived that *lov*ED means *love*-DID; but this affords no solution, DID itself being a past form, and thus requiring as much as any other past form to be explained. Dr Murray has thrown more light on the subject, at

Mode or Mood, and Voice.

least so far as etymological history is concerned, by showing that past action was originally signified by a mere duplication of the name of present action, eventually contrasted and modified; or, in other words, that the sign of the past tense, in most languages, is no other than a disguised form of the verb in present time, together with a terminal addition. But, admitting the fact, the device seems far from being very logical; and, at all events, a process more philosophical, and at the same time quite analogous to what has already been explained in regard to future time, presents itself, in the circumstance of the auxiliary verb TO HAVE being the proper and peculiar sign by which to indicate past action, just as *may, can, shall,* or *will,* indicate future action. It would be a remarkable proof of this process having been adopted, if it could be shewn that the termination of the past tense in English is derived from the word HAVE. This word, which is conjectured to have originally meant *hold* or *haud,* from which, possibly, may have been derived the past termination *ed,* or *d,* indicates that the annexed action is perfect, and therefore *past.* But, as we can no more be said to *have a past thing* than to *have a future thing,* it is by a grammatical fiction only that we can be said to have a past action, precisely as in the former case we are said to have a future, *have* itself properly referring in both cases to what is present. On the whole, it would seem that no verb has any other time or tense than the relatively present.

For a similar reason, namely, that there can be no variety in the signification of an action, it is maintained that verbs cannot be said to have any *mode* or *mood.* The mind, indeed, thinks and expresses itself, with respect to actions, in different modifications, that is, according to its desire, power, command, that these actions shall exist. But these mental modifications are not modes of the actions themselves, requiring corresponding modes of signs; and accordingly, in our language, are not expressed by changes of the verbs of action, but by other verbs *in the declarative and present form,* the only form, as already mentioned, of which verbs are susceptible.

Proceeding on the same principle, it is demonstrable that there can be but one *voice* in language, namely, the *active,* and that it does not belong to a *verb,* but to the mind, which alone affirms or denies. A state of *passivity* is expressed by an adverb or abbreviated speech, signifying that the nominative, *representing the sufferer, is actively in a suffering state.* What are called *number* and *person* belong not to *verbs* but to *nouns* or *pronouns,* as is very philosophically manifested in the fact of the English language identifying the *form* of the *first person singular* of a verb with the *common form of all the three persons plural,* the number and the persons being indicated, not by the verb, but by the annexed pronouns. It seems to have been from mere carelessness or inadvertence that the so called *second* and *third persons* singular of English verbs were varied, as we now find them, from the common form of the other persons, Dr Murray having shewn that the terminations ETH and S are in reality *the old pronouns of the corresponding persons,* which ought to have been discarded when the new pronouns were first put *before* the verbs as they now are.

Supposed Auxiliary Verbs.

The nature of what are called *auxiliary* verbs may be easily understood from the preceding observations. They are, in reality, just as distinct and complete verbs, that is, be it always remembered, when used as signs of actions or relations between two relative subjects, as any other verbs, and have the very same structure; and they become, or are verbs, only because, like other verbs, they are names of actions so placed. The actions or relations which they express are those of the mind, or *any grammatical person,* represented by a noun or pronoun, which is always the subject or nominative of the auxiliary verb, while the *adjective act,* represented by its *name* together with the prefix TO, (generally omitted, but always implied,) which constitutes the so called infinitive mood is the object or co-agent of the auxiliary. Thus, the expression " he will love her," is elliptical, and means " he will to love her;" and in this sentence, according to the principle of alternation formerly explained, and which is equally applicable here, the expression " to love" is, first, an objective noun to the auxiliary verb WILL, and next a verb, the nominative of which is the *noun of auxiliary action* WILL, and its accusative the pronoun HER. From this view of their nature, it is manifest that the number of auxiliary verbs is much greater than grammarians generally imagine; for, to the common list in our language, *may, can, shall, will, ought, let, must, am, do, have,* might be added, with equal propriety, *love, hate, fear, wish, hope,* and many more, every one of which, like any of them, is or may be used as the sign of a *primary mental act.* It follows that the *inflecting* languages, those, *e. g.* of Greece and Rome, which employ *terminations* to signify the mental actions *shall, will, may, can,* &c. are, notwithstanding all their complexity, very far from being complete, inasmuch as they have not terminations sufficiently numerous to express any thing like the whole list of auxiliaries. Were they fully supplied with them, as their genius and principle of structure require, they would present vastly greater difficulties in the way of acquisition, than those, serious enough, as is commonly found, with which we have now to contend. Mr Fearn quotes Mr Grant, an author of a recent work on English grammar, as having the merit of suggesting a more correct doctrine regarding the nature of auxiliary verbs than had previously prevailed,—and a single sentence will prove, that the views of that gentleman and his own, on the subject, are very like, indeed are precisely the same as to one important particular. " Such words as *have, may, shall,* ought to be considered as verbs, and leading or principal verbs too, rather than auxiliaries in present time."

Mr F. was not aware of the fact, that Dr Hunter of St Andrews had been in the habit, for nearly half a century, of delivering, in the course of his lectures, very similar opinions, so far as the nature of auxiliary verbs is concerned. It is no more than justice to that able scholar, to give a brief notice of his sentiments as they appear in his exceedingly valuable little treatise on the Tenses of the Latin Verb, appended to his edition of Ruddiman's Rudiments, published in 1820. The reader cannot fail to be pleased with their ingenuity, and will, in all probability, be induced to think, that, taken in connexion with the preceding remarks, and fully prosecuted, they may lead to some important conclusions.

It is almost impossible, in our present state of knowledge respecting the Latin and Greek languages, to analyze the moods and tenses of its verbs, so as to arrive at the elements, the combination of which has produced them. But we are furnished with something like a guide to them in the decomposed state in which the corresponding modes and tenses of the verbs in English and other modern languages are formed. Thus, by means of the verbs termed auxiliary, we have *scripsero* represented to us by *I shall—have—written.* Attention to these auxiliaries, therefore, though not alone sufficient, is of material use in explaining the moods and tenses of the learned languages. The modes and habits of thinking common to mankind, and the peculiarities in the inferences drawn from words, must, also, be carefully regarded. The so-called verbs, usually employed and considered as auxiliaries in English, have been already enumerated, *am, do, have, will, shall, may, can*; and, as is well known, it is by means of these we render literally the Greek and Latin moods and tenses of verbs. But, it is obvious, these auxiliaries, when combined with nouns, constitute the predicates of propositions, and, accordingly, express *assertions*, either affirmative or negative; from which it follows they are all verbs in what is called the *indicative mood*. This is manifestly the case in such examples as, *I do, I have, I shall*, and, in short, in every other instance of combination of a noun substantive with an auxiliary verb. Even in examples of such combination, followed by what is generally deemed part of another verb, as *I will write*, there is nothing *really expressive of a future state*, although every person acquainted with the language understands it to import a declaration as to *future writing*, which is only deduced from what is predicated, namely, the *will, inclination, or intention to write*; or, in other words, the *future action* is inferred from the *present volition*. Those auxiliaries, then, are all verbs in the indicative mood, and all, when combined with a noun or subject, express an assertion, which they do also when followed by another verb; whence it follows, that the terms of what grammarians call the subjunctive, potential, or optative mood, which, as has been shown, involve and are rendered by those auxiliaries, are also *indicative*; that is to say, such expressions as, *I* MAY *write, I* DID *write*, are equally *assertions*, or of the indicative mood, as *I* DO *write, I* DID *write*. What is *indicated* by them is no doubt different; but, in respect to assertion, they are perfectly of the same nature. Farther, it seems evident, such expressions as *I* MAY *write, I* MAY *read, I* MIGHT *write, I* MIGHT *read, I* MAY *have written, I* MAY *have read*, are not and ought not to be considered *moods of writing and reading*;—for, if they be modes or moods of any thing, they are so of the verb *may*, which is the generic term requiring to be modified or qualified; the other verbs, supposing them such, namely, *write* and *read*, being annexed to it for the very purpose of specifying the intended modification. The term *may* is used to predicate *liberty* in general of the nominative or subject combined with it; but the expressions *may read* or *may write* are qualifications of that term, and predicate liberty, not in general, but of a particular kind, *liberty to read and to write*, that is, they are moods of the verb *may*, not of the verbs *read* and *write*. A similar remark is applicable to all the other auxiliaries, which, being in reality the *generic verbs*, are, in our own languages, made to precede, in a separate state, those verbs to which they have been conceived to act the part of *auxiliaries*; whereas, in some other languages, they or the corresponding terms are subjoined, that is, appended to these verbs, and, from the circumstances of being unemphatical, and as it were adhering to them, have come at last to be considered as mere *flexions* or *terminations*, and to be so disguised or changed by abbreviation or elision, as hardly, if at all, to be distinguishable. This is particularly the case with the moods and tenses of the Greek and Latin verbs, the auxiliaries annexed to the end of which are, if at all discoverable as having been separate verbs, not prefixed, as in English, but subjoined to and ultimately amalgamated with them. Such at least, reasoning on analogy, is the probable origin of those terminations; for, beyond all doubt, they are similar in their nature and use to our auxiliaries, and, like them, contain the generic part of the expression, which is modified by the radical element of the verbs with which they are combined. Thus, the termination AM in *scrib*-AM, *leg*-AM, *teg*-AM represents *I may*, or *I can*, and receives modification from *scrib, leg, teg*; so that these expressions are most improperly denominated moods or modes of the verbs *scribo, lego, tego*, and really denote modifications of the general notion of *liberty* or *power*, by the notions of *writing, reading*, and *covering*. The English auxiliary verbs, therefore, determine the nature of the *moods* of the learned languages, which, by whatever names distinguished, as *subjunctive, optative*, or *potential*, are all equally assertive, or, so to speak, *indicative*. But these auxiliaries will be found no less illustrative of the *times* or *tenses* of the moods in question. They are evidently all verbs of the indicative mood; and, farther, they are all verbs of the *present* time, each of them having a correspondent form to denote *past* time, as

Pres. *Am, do, have, shall, will, may, can.*
Past. *Was, did, had, should, would, might, could.*

It may be expected, accordingly, that the flexions or terminations of the verbs of the learned languages, which involve or imply these auxiliaries, should be either of the *present* or the *past* time. In short, whatever these terminations predicate of their subject, whether *existence, action, possession, duty* or *obligation, volition, liberty* or *possibility, ability* or *power*, they will be found, like the corresponding auxiliaries, to have two forms, one of which serves to predicate those attributes of the *present* time, and the other of the *past*. Separating, then, the idea of *time* from the other circumstances involved or signified in the moods and tenses of the Greek and Latin verb, and attending to it exclusively, Dr Hunter regards it as either *present* or *past*, in reference to which, as two *fixt points*, he conceives all the other ideas denoted are to be determined. In stating this opinion, he confines himself to the genius of the Greek and

Latin languages, as to which he is possibly right; but material modifications would be requisite in speaking of other tongues. For example, the tenses in Hebrew, which are only two in number, are the *past* and *future*, the former, or the so called *participle active*, being often employed to denote the *present tense*, the want of which, except in what are called the substantive verbs, is a striking enough point of resemblance between that early language and all the British dialects of the Celtic. Moreover, it is proper to notice, several of the auxiliary verbs, of which Dr Hunter has treated as of the present form, seem actually to imply something of futurity. But these are peculiarities, into any discussion on which it would be ill-timed to enter in this place. It may not be improper to observe, however, that a much wider survey of such peculiarities than is usually had recourse to, is quite essential to philosophical theories of language, and will generally be found sufficient to point out fundamental errors in those which are not strictly so.

The words denominated auxiliaries are as evidently verbs, when used, according to Mr F's. system, to express or designate relations, as any other words to which that name has been universally given; and it is ignorance of their origin and import, together with inattention to their use, which has obtained for them a title totally inappropriate to their real nature and character. In place of being *auxiliaries*, understanding thereby some things subordinate to, and employed in aid of others, they are principals or primaries wherever they occur; and, in point of fact, therefore, as might be expected, they do occur more frequently than any other verbs, and that in two states, namely, as standing alone, or unconnected with other verbs, and again in various combinations with them. In the former case, they possess, or are used as, significations of so general a kind as to predicate existence, duration, power, volition, obligation, action, possession, &c. of their objects or agents; in the latter case, these general significations are qualified and limited by the terms with which they are connected; and these terms are essentially nouns, expressive either of these subjects or qualities in the abstract, or of certain special actions and conditions considered in relation to their objects or agents. It is highly probable, that these so-called auxiliaries are not only *primary* in regard to meaning, but are also of earlier date in the progress of language. Nay, it is quite conceivable, that they may have arisen from, or actually constituted, some of those interjectional monosyllables, in which, according to the views of Dr Murray, our ancestors originally expressed themselves; but with this difference, that, whereas the primitive articulate sounds of which he speaks were employed to denote material actions, or the changes in the state of external nature, the terms in question were designative of those internal operations and emotions, of which it is presumed, every human being must be conscious, even in the rudest condition of the species. If this notion be correct, it would follow, that we possess in these very terms the materials of an intellectual language; and, therefore, contrary to an opinion common among philosophers, are not necessitated, in speaking of mental phenomena, to employ exclusively, if at all, a system of signs originally appropriated to material or external objects. It is only an extension of the same idea and mode of reasoning, to consider of a similar nature all those words, which were formerly alluded to, as capable of being used, like the so-called auxiliaries, to designate mental acts, namely, *love*, *hate*, *fear*, *desire*, *hope*, &c. when qualified by following or connected words. Perhaps, then, it would be proper to apply to all of these a title, expressive, much more assuredly than the term auxiliary is, both of their common origin and similar use; but, at the same time, a classification of them ought to be made into orders and genera, the characteristics and denominations of which might be taken from the principles of human nature pointed out by them. Farther, proceeding on the maxim, that words, more especially such words, are the signs or representatives of real existences, whether substances, qualities, attributes, or acts, it would appear to be quite philosophical to infer their constituents, or things represented, from their ascertained and generally admitted meaning; and hence, confining ourselves at present to these signs of mental operations, we might expect to arrive at something like a rational and comprehensive view of the number and diversities of the powers of the human mind, employing that phrase in its largest acceptation, but without concerning ourselves, at least in the first instance, with any questions regarding the essence, the unity or the plurality, the locality or situation, the organization or the connexion of the mind. How far these questions may be capable of partial or entire solution by the principles of language thus applied, is itself a matter of enquiry of the very highest importance and interest, but not to be entertained in this place. Then, supposing, what there is no reason to doubt, that the flexions or terminations of the verbs in some languages, especially those of Greece and Rome, correspond in signification and power with our so-called auxiliaries, it would be desirable to trace the former to their primitive and entire forms; and, in investigating the affinities between these and other languages, so far as etymologies can be useful, it is advisable to pay particular attention to their resemblance and dissimilarities in this respect. Again, as it hath hitherto been found extremely difficult, if not impossible, in our present condition of ignorance, respecting the origin and early state of these languages, generally to trace these flexions to their parent verbs, which, nevertheless, we cannot doubt to have once existed, we may, with propriety, have recourse to some new or additional measures for the discovery and recognition of them. Possibly, in some cases, the original words may have been divided in such a manner, as, that, parts of them were used as *prefixes*, and other parts as *postfixes*, or even, so to speak, *medio-fixes*, to the modifying words; occasionally these parts may have been so far changed, for the sake of euphony, or other reason, as to have lost their characteristic, or, at least, original features; for similar reasons, the modifying words may have been changed to an equal, if not a greater degree; combinations may have been formed among such parent words and

A Natural Order of Verbs.

those words which were used as what are called personal pronouns; these combinations may either have been *proper*, that is, without repetitions, or double representations of the same things, or *improper*, that is, superfluous, such as, according to what was formerly shewn, can be proved to be the case in English,—where, besides prefixed pronouns to denote the second and third persons, we find the terms ETH and S, postfixed to the verb for the same purpose; and these, and such like combinations, may have given rise to new words, which themselves may have been operated on precisely in a similar manner, so as to occasion extreme complexity of appearance, and no less difficulty both of interpretation and analysis. For the more speedy and correct acquisition of a knowledge of the verbs, certainly a laborious task, in all languages, it would seem to be advisable to exhibit these terminal or other adjuncts, considered as the representatives and remains of mental verbs, in a separate form, that is to say, in distinct paradigms, with their appropriate and usual meanings, so that when the student thoroughly mastered them he might proceed to make additions from various nouns of action. In this manner, it is imagined, he might learn to conjugate, as it is technically called, with a degree of intelligence as to the rationale and principles of the process, not so easily or so early attained in the common method of the schools. This would be merely an extension of the practice judiciously adopted in the elementary treatises on some languages, as lately by Dr Stewart in his Gælic Grammar, in which the so-called auxiliary verb, corresponding with the English "to be," and used in the formation of the *compound tenses*, is properly given at the very commencement of the chapter which treats of verbs. Perhaps it is of little consequence in what order these so-called auxiliary verbs, comprehending generally what we have styled mental verbs, are given; but, as much as is practicable, a natural arrangement ought to be adopted. Suppose, then, taking in both complete words and flexional fragments, we give precedence to the substantive verb "to be," or, more correctly speaking, to that word which is used to denote *existence*, that is, the relation between a being and time, whether past, present, or future. This might be followed by the word, if there be any such word in known language, which denotes the relation between a being and space, or change of place. Then might come in succession those words used as verbs, which signify the relations between a being and *something done*, between a being and *something made or become*, between a being and *something wished* or *desired*, between a being and *something seen or perceived*, between a being and *something acquired* or *attained*, between a being and *something kept or held*, between a being and *something remembered*, between a being and *something conceived*; and these, again, might be followed by words signifying peculiar or specific mental operations or actions. As no one language, it is certain, is so perfect as completely to fill even this or any other outline in a regular manner, some change might be requisite for the sake of accommodation to particular cases; but, be this as it may, it is exceedingly probable, that advantages of sufficient importance would warrant a considerable deviation from the ordinary procedure of school-grammars as to this point.

Particles.

We have occupied so much room on the subject of the verb, that we can only allude in very general terms to another field of inquiry and discussion, from which, it is confidently believed, there is a large portion of fruit yet to be obtained by industry properly directed,—that which grammarians denominate by the vague term *Particles*, of which, for various good reasons, Mr Fearn, whom we now profess to follow, has selected the class of prepositions for immediate notice. It is on this topic, almost universally considered the strong hold of Mr Tooke, and the basis on which his high repute as a philosopher rests, that he is in a special manner, and, as it seems to us, with unequivocal success, assailed in the work now analysed. In the notion, that prepositions, distinguished as a separate part of speech, are not a species of words essentially, or in any manner, different from the other parts," there is an entire concurrence of judgment between these two authors; and, indeed, such a proposition, which, it may be mentioned, is virtually and by implication that of Mr Horne, naturally flows from Mr F.'s principles formerly laid down. Farther, it is conceded to Mr Horne, that many of the so-called prepositions, are "words disguised by corruption." But the concurrence is too general to produce much harmony between them, and the concession too qualified to enhance the honour of Mr Tooke as an etymologist. Accordingly, to the whole theory of that gentleman respecting the necessity and use of prepositions, Mr F. not only demurs, but positively protests, as a matter completely unfounded and visionary; while, without professing, in this part of his work, to occupy himself in such investigations, he does not hesitate to point out some gross errors as to the origin and meaning of certain words, advanced rather vauntingly by his eminent predecessor in support and illustration of doctrines, which, by their novelty and seeming importance, as well as the ingenuity with which they were maintained, promised to effect an entire revolution in this very intricate department of language.

The essence of Mr Tooke's theory may be thus stated. As the *article*, or an equivalent invention, is necessary to supply the place of a distinct name or *particular term* for every particular *idea*, so the preposition, or an equivalent invention, is rendered necessary by the impossibility of having a distinct *complex term* for each different *collection of ideas*. Words of this class prevent such complex term being too numerous, and operate in a very simple way. "For, having occasion in communication to mention a collection of ideas for which there is no one single *complex term* in language, we either take that complex term which includes the greatest number, though not *all*, of the ideas we would communicate, or else we take that complex term which includes *all*, and the fewest ideas *more*, than those we would communicate; and then, by the help of the preposition, we either make up the deficiency in the one case or retrench the superfluity in the other." The instances chosen to show these two propositions, are, 1st, The house WITH a party-wall; and, 2d, A house

WITHOUT a roof; in the former of which the complex term is deficient, so that the preposition "*directs* to add" what is wanting; and, in the latter, the term is redundant, so that the preposition "*directs* to take away what is superfluous. To this statement, it is right to add, that Mr Tooke asserts prepositions and conjunctions to have been originally and still to continue *all one same class of words*,—an opinion in which, as substantially in his general sentiments on the subject, he has been followed by Dr Murray and other writers.

Now, in opposition to this theory and the connected assertion, it is maintained by Mr F, that all so called prepositions are verbs, that is, *dependent verbs* in relatively present time; and that prepositions and conjunctions form two most different classes of words. The use of prepositions he conceives to be two-fold, namely, 1st, To define the manner of beginning or terminating any principal action, which, of course, is expressed by its own sign, or the MAJOR VERB, so that the preposition may be called the dependent or MINOR VERB; and, 2d, To serve as the signs of actions or relations between some nouns in the definitive case and some other nouns thereby defined. We have an example of the first in "he comes to London;" in which the principal action is denoted by *comes* the major verb is defined by *to*, the minor verb, used to denote the dependent action of *finishing*; and an example of the second in "Joan of Arc," in which the preposition *of* meaning *offspringing*, is the sign of the action or relation between Joan and the place of her designation. In this last instance, the preposition, though it appears to stand for a single or solitary action, and not a defining or dependent one, must nevertheless, in the nature of things, be resolved into the sign of a dependent and defining action, as in the first example, for, generally speaking, we cannot conceive any noun put in any case without involving the conception of that case depending on some action which is grammatically major or principal with respect to the action forming the case.

As to conjunctions, again, it is maintained, that such of them as are *imperative*, (the only species which the enquiry can concern,) are *abbreviated signs of whole speeches or sentences*, that is, *compound sentences*; and, in consequence, that they never can be verbs. To recur, then, to the two examples adduced by Mr Tooke, it is affirmed, that he has been "misled by etymology" to construe *with* and *without* as imperatives, that is as *imperative conjunctions*, whereas they belong in reality to the class of words called prepositions, here considered as minor verbs in the *progressive participle form*. The difference between these two views will be clearly perceived in the corresponding reduction of the phrases in question. Thus, according to Mr Tooke, we have

A house, *I direct you that you add* a party-wall.

A house, *I direct you that you take away* a roof.

And, on the other hand, according to Mr Fearn, we have

A house WITHING (i. e. *tying*,) a party-wall.

A house WITHING OUT (i. e. *tying out or tying the want of*) a roof.

Farther, it is observed by the latter named author, that, "so far are imperatives from being necessary to express either the *added* or the *subtracted* "IDEA" in these examples, (as Mr Tooke imagines) that we can express the very same addition or subtraction, and *this more concisely*, in two other ways, without using the clumsy and in fact the inadmissible instrumentality of an imperative. For, not only can we say, "a house JOINING a party-wall," but, besides this verbal form of expression, we could express the very same "collection of ideas" by a *mere adjective*, thus, "a PARTY-WALL house;" just as we say "a DOUBLE-BARREL gun," or "a BROAD-WHEEL WAGGON." Hence, then, it seems, imperatives are not necessary to prevent complex terms from becoming too numerous; and, on the other hand, it can be shewn, that there is a certain class of words, namely, *numeral definitives*, necessary to save an intolerably numerous repetition of *imperatives* in those cases in which imperatives *do* or *could* enter into complex terms. Thus, in place of "a man AND a man JOIN a man AND A MAN JOIN a man," &c. &c. up to the amount of a *thousand*, we use the numeral definitive so called, and thereby save the *nine hundred and ninety-nine* repetitions of the *imperative* AND or JOIN, besides as many of the noun MAN, which that imperative would otherwise have connected with the first noun *man*. Moreover, the assumption that prepositions *direct* us to add or take away is quite unwarrantable. Their import, like that of verbs, is simply to connect the preceding with the following noun, and they do so by their own grammatically intrinsic power. Lastly, Were they to be considered as imperatives, as some of Mr Tooke's supposed etymologies inclined him to believe they ought to be, they would, in reality, invert and falsify the reciprocal state of relativeness between the objects spoken of, and thus express the direct opposite of what the sentences in which they occur are generally understood to signify. Altogether the reasonings brought against the views of Mr Tooke, seem of the most cogent kind, and they are capable of being supported by deductions from the very source, namely, etymology, to which that author appealed with such confidence,—a sufficient number of the *roots* of real prepositions remaining in their proper verbal or participial forms, to prove their origin, connection, and import, to be very different from what he imagined them to be.

On the whole, therefore, it is considered a position which may be safely maintained, that prepositions are essentially of the same nature as verbs, the sole difference between them and other verbs consisting in the circumstance of their being signs of actions in some way logically and grammatically dependent on other actions, which latter are logically and grammatically principal in regard to them. This theory readily explains the occasional existence of more than one preposition in a sentence, as it is obvious that it is frequently necessary to express more than one dependent action, and even to connect several such actions in a series, in which, it may be remarked, every succeeding verb, or sign of action, is more gramatically dependent than the one which preceded it, and all of them depend on some

Prepositions, &c.

principal verb. The classification of these words, that is, the division of them into various kinds, is founded on principles which need not now be investigated. But it may be proper to mention, that a very important and numerous tribe of them is constituted by the GENERAL NATURE OF ACTION, to which neither grammarians nor logicians have given the attention due to its cogency, but for the explanation and illustration of which, under the title of "the three-fold structure of action," as consisting of a *beginning*, a *continuing*, and an *ending*, each of them marked and followed by its own peculiarity, we must refer to Mr F.'s singularly ingenious and profound work.

It cannot be doubted, that correct views of the fundamental principles of language are essential to its right application and use in all the kindred departments of literature. Logic, to be any thing better than noisy disputation, must be founded on the laws of thought, as exemplified and represented by words: Rhetoric avails itself of the same means and partakes of the same constitution: The *essence* of Poetry is to be sought for in the creative power of the human faculties, and especially the operation of one of them, the general function of which seems to be to excite the rest to the conception of more than is observable in nature, and the consequent expression of more than is strictly and literally according to truth; but tho' this essence, from the number of the sources in which it may have its origin, or the diversity of the powers capable of being so excited, pervades all the productions of the fine arts, properly so called, and is by no means confined to arbitrary or conventional language for a vehicle, yet, when it assumes that medium of communication, it is, equally with logic and rhetoric, amenable to those laws which it is the business of philosophical grammar to establish: The principles of Translation, again, it is very obvious, must have all their validity from the same source, in conjunction with those peculiarities in the genius of different languages, which, though probably founded on the constitution of human nature, cannot be ascertained by any process of general reasoning: and, lastly, Criticism, as employed in any particular use of language, must necessarily be influenced by its fundamental laws, whether directly applied, or as recognised in any or all of the departments of literature now enumerated. If, to go no farther, these varied and important bearings and relations of language be duly estimated by the reader, who, at the same time, is any way alive to its intrinsic interest, his time and labour will not be thought ill bestowed in considering an attempt, which, either by its success throws new light, or, by its failure, confirms the common opinion, on the subject.

General Remarks.

# PHILOSOPHY.

Definition.

PHILOSOPHY, defined by Dr Johnson, "Knowledge, natural or moral," and "The course of sciences read in the schools," comprehends all those doctrines which relate to matter and to mind, considered as having different natures, and manifesting various properties or qualities. The titles, natural philosophy, or physics, and moral philosophy, or metaphysics, are commonly used to denote these two departments of knowledge, each of which is capable of being subdivided. Thus, under the former we have astronomy, optics, electricity, magnetism, &c. all of which have been treated in their proper order: under the latter, may be enumerated pneumatology, or the doctrine of spirits; the philosophy of the human mind, to which, also, the names of noology and phrenology, might be, and have been applied; ethics, or the doctrines respecting the use and direction of the faculties, with a view to duty and happiness; theology, or divinity, that science which relates to the character of the Supreme Being, made known both by his works and direct revelation. Of these various branches, and several others which might be mentioned, very different arrangements have been given. Lord Bacon, in his "General Distribution of Human Knowledge," classifies philosophy under reason, and arranges it into various departments. From his arrangement, two very extensive topics are excluded, namely, history and poetry; though both of them amenable, in reality, to general philosophical principles; Bacon, according to his own views of the faculties of the human mind, having referred the former to memory, and the latter to imagination. D'Alembert adheres to Bacon's arrangement, but with some modifications. It is liable to several objections, even on the ground of the metaphysics of the schools, as Mr Stewart has shewn in the preface to his Dissertation appended to the Encyclopædia Britannica, where the opinion is maintained, that "every future attempt of the same kind may be expected to be liable to similar objections." It is certainly quite manifest, that taking, in the widest sense, history, to denote and comprehend all our knowledge of particular facts and particular events; philosophy, all the general conclusions and laws inferred from these facts by induction; poetry, all the arts addressed to the imagination,—there are subjects, as, for example, the branches of pure mathematics, which are not included in the survey. Still, the advantages of such an arrangement, faulty as it may be, are sufficiently great to redeem its proposer from the charge of idle speculation; and may be expected to be tempting enough to excite others, to endeavour, at least, to perfect what he commenced, or to substitute another in its place. Mr Stewart is most liberal in Bacon's praise, while his language on the subject is far from being encouraging to other labourers. "In examining," says he, "the details of Bacon's survey, it is impossible not to be struck with the minuteness of his information, as well as with the extent of his views; or to forbear admiring his sagacity in pointing out, to future adventurers, the unknown tracts still left to be explored by human cu-

Arrangement.

Arrangement.

riosity. If his classifications be sometimes artificial and arbitrary, they have, at least, the merit of including, under one head or another, every particular of importance; and of exhibiting these particulars with a degree of method, and of apparent connection, which, if it does not always satisfy the judgment, never fails to interest the fancy, and to lay hold of the memory. Nor must it be forgotten, to the glory of his genius, that what he failed to accomplish, remains, to this day, a desideratum in science,—that the intellectual chart delineated by him is, with all its imperfections, the only one of which modern philosophy has yet to boast; and that the united talents of D'Alembert and Diderot, aided by all the lights of the eighteenth century, have been able to add but little to what Bacon performed."

The great error of Bacon's arrangement lies deeper than Mr Stewart seems to have thought, and must vitiate every other system founded on metaphysical principles. It consists in the notion of the human faculties being capable of division under the heads of *memory*, *imagination*, and *reason*, and in ignorance of, or inattention to the fact, that these are merely modes of activity, common to most, or all of the faculties, and not the faculties themselves. It follows from this fact, that any of the subjects, classified under one of these heads, might, with equal propriety, if viewed in a different manner, be classified under another; and, in consequence, that the arrangement is altogether arbitrary, or dependent on the particular intellectual exercise of individuals. We shall put an analogous case, for the purpose of explaining this remark, and demonstrating its importance. Conceive, then, that we had to arrange the objects of the external senses, namely, *touch*, *taste*, *smell*, *hearing*, and *sight*, and that in ignorance of, or inattention to, the number and the nature of these senses, we were, nevertheless, aware of some of their properties or the circumstances in which they agreed; and that, accordingly, we adopted the names of these properties or circumstances for the grand divisions in our classification. Let us call them *sensation*, *perception*, *abstraction*, *memory*; and, under these, let us proceed to place the various elements or component parts of the material world, or the sciences and arts which relate to them. It is evident that their positions must entirely depend on the view we take of them, or the relation in which we please to make them the subjects of our contemplation. Sensation is common to all the senses, and, for the sake of argument, we may affirm the same of perception, abstraction, and memory. Under sensation, therefore, or under any other of these terms, we might arrange any or all of the objects of the senses, just as we regarded them at any particular time, or in any particular manner. The rationale of arrangement is obviously faulty in this instance, and, in place of it, we must, if possible, discover, not what is common to the senses, but the number and the differences of the senses; and, having made the discovery, we are put in possession of those principles which nature herself has recognized as the basis of classification. In precisely the same manner must the arrangement of the objects of our intellectual and moral powers be constituted, and the sciences and arts, or, so to speak, the departments of human knowledge, dependent on or resulting from them. Considering the terms memory, imagination, and reason, then, as merely expressions for the operations of the faculties, and abandoning the vague and really interminable controversies regarding their distinctions and limits, we must endeavour to ascertain the number and the differences of our primitive powers, or the actual distinctions observable among our feelings, propensities, sentiments, and affections; and, when we have completed the survey, but not till then, we may commence the task of classification with a well-founded hope of success. We shall only add, for the sake of its utility, that this mode of reasoning is just as applicable to what is usually called the philosophy of the human mind, as the analogous supposition regarding the senses would have been to any science which professed to treat of them systematically as a branch of philosophy. The error now alluded to is precisely an example of the unphilosophical method of procedure to which the reproofs of Bacon were addressed, namely, the formation of a world out of one's own conceptions, or drawing the materials of philosophy from special habits and exercises of the mind, in place of having recourse to experience and observation, or, in other words, to the facts and objects presented in the book of nature. "That," says he, "I call anticipations, the voluntary collections that the mind maketh of knowledge, which is every man's reason. Though this be a solemn thing, and serves the turn to negociate between man and man, because of the conformity and participation of men's minds in the like errors, yet, toward inquiry of the truth of things and works, it is of no value."

Causes of Error.

A summary view of the system of logic, or the instrument, by which Bacon proposes to extend and improve the state of human knowledge, may be properly given in this place, as equally applicable to all the branches of philosophy; and, following his example, we commence with enumerating and explaining the causes of error, or those circumstances in the character of men, or the usage and employment of the mind, which have obstructed, and are always apt to obstruct, the progress of science.

These causes of error or obstructions are denominated by him *idols*, false divinities, or appearances, and are reckoned of four kinds, *idola tribus*, (idols of the tribe); *idola specus*, (idols of the den); *idola fori*, (idols of the forum); and *idola theatri*, (idols of the theatre). "These four," he says, "added to the incapacity of the mind, and the vanity and malignity of the affections, leave nothing but impotency and confusion." Each of them comprehends many subdivisions.

The first, or *the idols of the tribe*, are those causes of error which have their foundation in the human constitution, and are, therefore, common to mankind. Perhaps the most satisfactory explanation or theory of them that can be given, is, that, generally speaking, mankind are so constituted as to interpret all things in relation to themselves rather than in relation to any other object or point. The *idols of the den* arise from the peculiar constitution of individuals, those circumstances of character, intellectual

General Caution.

and moral, by which every man differs from another. It is easy to understand, and seems almost universally admitted, that, besides the common properties or faculties of human nature, there are such modifications which serve to diversify the members of the species. Every individual, then, besides his liability to the errors depending on the former source, has a propensity to what may be called a special delusion, or, to use the idea of Bacon, has a den or cavern, in the darkness of which he is apt to sacrifice truth to some darling but deceitful idol. The *idols of the forum* are such errors as spring from the intercourse with the world, in the common or every-day occurrences and concerns of life and society; and, more particularly, from the use and influence, or from various misconceptions respecting the meaning and import, of language. The *idols of the theatre* are those errors or false conceptions which are derived from the systems and theories of philosophers, who happen to have got into repute, probably more often without right than for good reasons. These systems and theories Bacon considers as so many representations brought on the stage, or so many theatrical productions, and hence the name which he has applied to them. The idols of this class, in place of springing up naturally or imperceptibly in the mind, like the other kinds, are usually the acquisition of thought and study badly directed or unprofitably exercised. Bacon considers *false philosophy* under three respects, or divides it into three species, namely, *sophistical*, *empirical*, and *superstitious*, all of which he illustrates and exposes, chiefly from the writings or known hypotheses of the ancients. The substance of his caution against all these idols, and the means by which they have been, as it were, fortified within the mind, is to be found in what he says of the proper end or object which men ought to have in view, by seeking the amplification of their power and kingdom over the world, and of the mode in which it is to be accomplished. "The access to this work hath been by that port or passage which the Divine Majesty, who is unchangeable in his ways, doth infallibly continue and observe; that is, the felicity wherewith he hath blessed an humility of mind, such as rather laboureth to spell, and so by degrees to read, in the volumes of his creatures, than to solicit and urge, and, as it were, to invocate a man's own spirit to divine and give oracles unto him. For as in the inquiry of divine truth, the pride of man hath ever inclined to leave the oracles of God's word, and to vanish in the mixture of their own inventions; so in the self-same manner, in inquisition of nature, they have ever left the oracles of God's works, and adored the deceiving and deformed imagery which the unequal mirrors of their own minds have represented unto them. Nay, it is a point fit and necessary in the front and beginning of this work, without hesitation or reservation to be professed, that it is no less true in this human kingdom of knowledge, than in God's kingdom of heaven, that no man shall enter into it, *except he become first as a little child.*"

We now proceed to the process by which alone, according to Bacon, nature is to be interpreted.

Process of Interpretation.

The first requisite is a history of the phenomena in all their variations, as presented to us either spontaneously, that is, without our interference, or in the way of experiment, as had recourse to for the sake of discovery. In this history, which, accordingly, is both natural and experimental, the facts must be faithfully related, and perspicuously arranged, all care being exercised to discriminate what is authentic and beyond a doubt, from what rests on insufficient or uncertain grounds. The next object is the comparison of the different facts, in order to the discovery of *causes* and *forms*, understanding, by the former, those circumstances of which some events or changes are the effects, and, by the latter, those circumstances of which the results are permanent qualities. Subordinate to forms are what Bacon calls the *latent process* and the *latent schematism*, or the invisible progress of the sensible changes, and the invisible structure on which the properties of bodies depend. We are to commence the inquiry into these causes and forms, by determining what things are or ought to be excluded, and thus limiting the field of investigation, and leaving only a small number of common principles, out of which one is to be taken, and the validity of this is to be tried by its application to the whole of the phenomena. Bacon's opinion of the necessity for adopting this mode of exclusion, as contradistinguished from direct affirmation, is expressed in forcible terms. "Omnino Deo (formarum inditori et opifici) aut fortasse angelis et intelligentiis competit, formas per affirmationem immediate nosse, atque ab initio contemplationis. Sed certe supra hominem est; cui tantum conceditur, procedere primo per *negativas*, et postremo loco desinere in *affirmativas*, post omnimodam exclusionem."

The process, called by Bacon *induction*, is applicable to every inquiry regarding both the natural and the moral world, and essential to its termination in useful knowledge. It is, properly speaking, a system of philosophical logic, and, in the judgment of Bacon himself, as extensive in its range, to say nothing of its superior nature, as the common logic of the schools.

Obviously, all facts are not of the same value in regard to what may be called a scientific theory, or a discovery of causes. Bacon, well aware of this truth, enters largely and minutely into the consideration of their respective or comparative import and bearing. His enumeration of them, under the denomination of *prerogativæ instantiarum*, comprehends many species, of which it is almost unnecessary, for the present purpose, to take any other notice than by mentioning the names he has given them. 1. *Instantiæ solitariæ*, examples either of a certain quality or property existing in two bodies which have nothing else common; or, of a quality or property differing in two bodies which in all other respects are similar or the same. 2. *Instantiæ migrantes*, examples of a quality or property which passes from one condition to another, and that either from less to greater, or from greater to less; or, as Bacon has it, "migrat ad generationem, cum prius non existeret; aut contra migrat ad corruptionem, cum prius existeret." 3. *Instantiæ ostensivæ*, called also *instantiæ elucescentiæ* or *liberatæ*, and *prædominantes*, namely, facts which shew the nature or property inquired

Process of Interpretation.

into, as it were, in a naked and substantive form, and at the same time in a high degree of efficiency and power, because freed from those obstacles by which it is, in other cases, impeded or confined. 4. *Instantiæ clandestinæ*, or *instantiæ crepusculi*, in some respects the opposite of the former, as shewing the nature or property in an incipient and weak degree, or, to use Bacon's own words, "tanquam in incunabilis et rudimentis suis." As the *instantiæ ostensivæ* display the *differences* of bodies, those *instantiæ clandestinæ*, on the other hand, are of great importance, in conducting us to the formation of *genera*, or, so to speak, in the generalizing of facts. 5. *Instantiæ constitutivæ*, or *manipulares*, which comprehends what may be reckoned general facts, namely those which constitute a species inferior to, but useful in the discovery of, the most general or a still higher cause. 6. *Instantiæ conformes* or *proportionatæ*, examples of resemblance or analogy in certain particulars, with diversity in others. 7. *Instantiæ monodicæ*, or *irregulares*, unusual or abrupt occurrences, or such as cannot well be reconciled to what is known of the other things of the same genus. 8. *Instantiæ deviantes*, very similar to the preceding, but presented in individual cases, and so often reckoned, as it were, errors, nature being imagined to have deviated from her ordinary course, as in the examples of monstrosities. 9. *Instantiæ limitaneæ*, very similar to the *monodicæ*, as being rare or extraordinary, and relating to species which seem to be composed of two species, or to comprehend rudiments between one species and another: as examples, Bacon notices some comets considered in relation to stars and fiery meteors; the flying fish between birds and fishes. 10. *Instantiæ potestatis*, presented in the most noble and perfect works of art, not excepting those which are merely curious, or on which much more labour is bestowed than is justified by utility or importance. 11. *Instantiæ comitatus*, examples of qualities or properties in combination, or which always accompany one another. To instances of a different kind, that is, of qualities always disjoined or separate, Bacon applies the term *hostiles*. 12. *Instantiæ subjunctivæ*, something similar to the preceding. 13. *Instantiæ fœderis*, examples of union of nature among things supposed to be heterogeneous. 14. *Instantiæ crucis*, or *decisoriæ* and *judiciales*, the first title being taken from the *cross* set up at the divisions of a road in order to point out the way; and accordingly, these *instantiæ* are such facts as, in the case of doubtfulness of judgment regarding two or more causes, determine which is the true one. 15. *Instantiæ divortii*, examples of separation, different from the *instantiæ hostiles*, for whereas, as Bacon says, "illæ (the latter) indicant separationes naturæ alicujus ab aliquo concreto, cum quo illa familiariter consuescit; hæ (the former) separationes naturæ alicujus ab altera natura."

These fifteen classes of *instantiæ* are addressed to the understanding, or, in the language of Bacon, serve or minister to the mind or reason in the interpretation of nature. To five other classes he has given the common name of *instantiæ lampadis*, or *informationis primæ*, their use being to aid and guide the senses. They are, 1. *instantiæ januæ*, or *portæ*, which strengthen or assist the immediate action of the senses; 2. *instantiæ citantes*, which enable us to perceive things otherwise or in themselves imperceptible, "sumpto vocabulo," says B. "a foris civilibus, quia *citant* ea ut compareant, quæ prius non comparuerunt;" 3. *instantiæ viæ*, which indicate the continuous motion or progress of nature, and which, accordingly, are likewise styled *instantiæ itinerantes*, or *articulatæ*; 4. *instantiæ supplementi*, or *substitutionis*, which supply or provide information when the senses themselves are altogether or greatly wanting: 5. *instantiæ persecantes*, which excite the attention or mind, as it were, "persecare naturam."

Universal Application of Bacon's Logic.

There remain seven other classes of *instantiæ*, to which, from their common application "*ad partem operativam*," or their use in deducing the arts from science, Bacon has given the common title of *instantiæ practicæ*. Their special names are, 1. *instantiæ radii*, or *virgæ*, by which we measure nature, "per spatia, non indefinita aut fortuita, sed finita et certa," that is, "per gradus spatii": 2. *instantiæ curriculi*, by which we measure nature, "per momenta temporis," : 3. *instantiæ quanti*, which measure qualities or properties, "per *quanta* corporum," or indicate how much of a body is requisite to a certain portion of the quality, or a certain effect: 4. *instantiæ luctæ*, which indicate the predominance and the concession of qualities in regard to each other: 5. *instantiæ innuentes*, which point out the advantage of mankind, or contribute to the useful purposes of life: 6. *instantiæ polychrestæ*, which relate to various concerns, or are advantageous on many occasions; 7. *instantiæ magicæ*, those examples in which the substance employed is small, or inconsiderable, in proportion to the operation accomplished by it, or the effect that results.

For an excellent comment on the logic of Bacon, and a just eulogium on his character as a philosopher, the reader is referred to Mr Playfair's dissertation, affixed to the Supplement to the Encyclopædia Britannica.

It is certain that this extraordinary man had chiefly in view the promotion of physical science, when he laid down rules for the guidance of those who professed to study nature; but, no one competent to judge of the subject can possibly doubt, that his general principles are equally applicable to the other great division of philosophy. A few expressions in his works imply his own conviction of the truth of this remark. What Mr Stewart says of him is quite correct. "In the extent and accuracy of his physical knowledge, he was far inferior to many of his predecessors; but he surpassed them all in his knowledge of the laws, the resources, and the limits of the human understanding." And, again, "Nor is it merely as a logician that Bacon is entitled to notice. It would be difficult to name another writer, prior to Locke, whose works are enriched with so many just observations on the intellectual phenomena." Dr Brown speaks still more explicitly as to the bearing of Bacon's labours on the science of mind. "The rules which he gives us are rules of *physical investigation*; and it is very natural for us, therefore, in estimating their value, to think of the erroneous physical opinions which preceded them, without paying sufficient attention to the false theories of intellect, which had led to those very physical absurdities. Lord Bacon, if he was not the first who discovered that we were, in some degree, *idolaters,* to use his own metaphor, in our intellectual worship, was certainly the first who discovered the extent of our idolatry. But we must not forget, that the temple which he purified was not the temple of external nature, but the temple of the mind; that in *its* inmost sanctuaries were all the idols which he overthrew, and that it was not till these were removed, and the intellect prepared for the presence of a nobler divinity, that truth would deign to unveil herself to adoration."

It was to the influence of Bacon's philosophy that Dr Brown himself was indebted for any light regarding the science of mind to be found in his writings; and we have an admission to this effect in a single paragraph. "The progress of intellectual philosophy may, indeed, as yet have been less considerable than was to be hoped under its present better auspices. But it is not a little to have escaped from a labyrinth so very intricate, and so very dark, even though we should have done nothing more than advance into sunshine and an open path, with a long journey of discovery still before us. We have at last arrived at the important truth, which now seems so very obvious a one, that the mind is to be known best by observation of the series of changes which it presents, and of all the circumstances which precede and follow these; that, in attempting to explain its phenomena, therefore, we should know what those phenomena are; and that we might as well attempt to discover, by logic, unaided by observation or experiment, the various coloured rays that enter into the composition of a sun-beam, as to discover, by dialectic subtleties, *a priori,* the various feelings that enter into the composition of a single thought or passion." The very title which Dr Brown chose to use in regard to his metaphysical speculations, namely, "the physiology of the mind," is a distinct avowal of his allegiance to the Baconian logic; and it may be safely said, that the real value of these speculations depends altogether on the fidelity with which he has adhered to it. A summary view of his doctrinal opinions on the subject of the mind may, therefore, be satisfactorily introduced in this place.

His primary and fundamental principle is, that all our feelings, of whatever order, or however called, as sensations, emotions, thoughts, are simply *states of the mind,* which bear to each other, or to corresponding affections of our bodily constitution, certain relations, either of *reciprocal antecedence and consequence,* by which they may be distinguished as *causes and effects,* or of *virtual comprehensiveness,* by which some of them must be regarded as complex and seemingly involving other feelings of a simpler kind as their elements. It follows, if it be not tantamount to, and synonymous with, this proposition, that all we know or can know of the mind, from the beginning to the end of life, is merely "its various states of changeful feeling,"—the feeling at each moment being its state at that moment, and, consequently, the series of its successive feelings being the whole series of its states. Now, it is conceived possible and proper to philosophize on those successive feelings or states of mind in the same manner as we philosophize on the changes of phenomena presented to us in the material world, that is, we can and ought to determine by observation, internal observation, of course, the order of their succession, and point out any other relation which they may appear to bear to each other. As the clear conception of what has now been stated is essential to the understanding of Dr Brown's arrangement of the mental phenomena and the various analyses on which portions of that arrangement are founded, it may be advisable to give the substance of it in a single sentence. Our sensations, then, our perceptions, thoughts, and feelings, however numerous and diversified, or, in a word, all the mental phenomena, are considered, not as different or separate from the mind, but as the mind itself existing in different states, which states can be subjected to observation and arrangement in the same manner as the successive phenomena of matter. "There is," says Dr B. "a PHYSIOLOGY OF THE MIND, as there is a *physiology of the body,* a science which examines the phenomena of our spiritual part simply as phenomena, and, from the order of their succession, or other circumstances of analogy, arranges them in classes under certain general names; as, in the physiology of our corporeal part, we consider the phenomena of a different kind which the body exhibits, and reduce all the diversities of these under the names of a few general functions."

If our observation and arrangement of these phenomena were fully and perfectly made, in the one case as well as in the other, the physiology of the mind and that of the body would be alike complete. That they are not so, arises both from the difficulties of the investigation, and the imperfect or erroneous modes by which it has been prosecuted. The most successful result possible, or the highest consummation of our labours, in the one department as in the other, can only be obtained in the undeviating prosecution of the laws of inductive logic. Dr B. urged this truth on his pupils with peculiar energy, and with a marked reference to a circumstance which seems to have frequently served as a plea for laxity of conduct in regard to that logic. "The exact coincidence, (as to the necessity of observation, &c.) of the physics of mind and of matter, it is important that you should have constantly before you, that you may not be led to regard the comparative indistinctness and vagueness of the mental phenomena, as a warrant for greater boldness of assertion, and looseness of reasoning with respect to them. There is, on the contrary, in such a case, still greater reason to adhere rigidly to the strict rules of philosophizing; because the less definite the phenomena are, the greater danger is there of being misled in discriminating and classing them. The laws of inquiry, those general principles of the logic of physics, which regulate our search of truth in all things, external and internal, do not vary with the name of a science, or its objects and instruments. They are not laws of one science, but of *every* science, whether the objects of it be mental or material, clear or obscure, Objects of Philosophical Inquiry.

definite or indefinite; and they are thus universal, because in truth, though applicable to many sciences, they are only laws of *the one inquiring mind*."

His illustration of the analogy between the philosophy of mind and that of matter deserves attention. Physical inquiry has one or both of two great objects in view,—the composition of bodies, and the sequence of changes which they undergo. In other words, we endeavour, on the one hand, to discover the elements and structure of the compound substances around us, and, on the other, what new appearances they exhibit in a variety of circumstances. The first of these objects is the province of *mechanical* and *chemical* division or analysis: the second is regarded in those inquiries which lead us, by a law of our nature, to arrange phenomena in the relation of cause and effect, that is, as the invariable antecedents and consequents, of the same phenomena in the same circumstances. "To know all the elements of every compound, and all the changes of which they may be reciprocally antecedent and consequent, would be to know every thing which can be physically known of the whole surrounding system of material things." In the philosophy of mind, in like manner, we have both to analyse what is complex, and to arrange the series of changes, or the successive feelings of our minds, considered also in the relation of causes and effects.

Dr B. conceives that this analogy will be universally admitted, so far as the observation and arrangement of the successions of phenomena are concerned in both cases; but anticipates an objection to that part of it which relates to the analysis of what is complex, on the ground that inquiries in the physics of mind, corresponding with those of the chemist into the composition of bodies, seem inconsistent with the simplicity and indivisibility "universally regarded as essential to our very notion of the mind itself." In reply, he admits, there would be such inconsistency "if the analysis in mind were professed to be strictly the same as in matter." But, setting out with the principle, that the mind is simple and indivisible, he maintains that every feeling of the mind, being only the mind itself existing in a certain state, must be equally simple and indivisible, and that, consequently, the analysis in the case of mind must "be virtual only, like the virtual complexity of the feelings on which it is exercised." According to this view, the analogy does not hold in one very important particular. This, perhaps, is of little importance. But the assumption that the analysis in the case of the mental phenomena is virtual only, not real, is a position to which his acute biographer and enthusiastic admirer, Mr Welsh, has objected with some anxiety. According to that gentleman, the apparent or admitted complexness of our ideas and feelings is real, though not in a manner analogous to that of bodies in the material world, which consist of an infinity of combined particles. It is a complexness of relations, not of substance, and is quite compatible with simplicity of substance. "The analysis of the mental physiologist, therefore, says he, seems to be more than virtual. It is not indeed, in the primitive meaning of the Greek derivation, a *losing* of parts, as in chemistry; but there is an actual change effected, and that too by separation or by alteration. If we suppose the mind to act by means of material organs, it may be erroneous to say that there is a removal of these organs from the mind, as that implies such a separation in space as we are not entitled to suppose; but there is, at least, such a change in the organ, that it ceases to affect the mind, or the mind is affected by it in a different manner: or if there is merely a succession of states, then there is a change in the antecedent state, by which the consequent state is affected." Mr Welsh conceives this statement to contain "a more simple and a more intelligible view of the nature of Dr B.'s very original investigation." We confess we think otherwise, and that to us it appears quite superfluous, because, so far as it is distinct and correct, it is precisely what Dr Brown himself has delivered on the subject in these words: "This analysis has not for its object what is truly compounded of parts, but a mere relation of seeming comprehensiveness, which, in certain circumstances, it is impossible for us not to feel, of one state of mind to other states in which the mind has before existed. It is not the less important, however, on that account, as a branch of physical inquiry, nor the less inexhaustible in the result which it affords. Almost every feeling is susceptible of this reflective analysis, in some greater or less degree; and inquirer after inquirer, in the field of mind, may evolve to us unsuspected elements of thought and passion, as chemist after chemist, in the world of matter, presents to us elements that never had been perceived by us, in substances which may have been before us from the moment of our birth." We apprehend all that Dr Brown intended was, that a state of feeling, *seemingly* complex, or by us so considered, that is to say, a feeling having a relation of seeming comprehensiveness, may have its *seeming elements* evolved to us in the same manner, as if, speaking of the conception of a Centaur, he says, "these elements were truly, and not virtually only, included in the more general feeling that seems to comprehend them." Were we to object to this part of Dr B.'s doctrine, or, more strictly speaking, to this preliminary proposition, we should do so on a different ground, and we imagine with some force. Without denying that the mind is simple and indivisible, we would say, the assumption that it is so, or, to use Mr Welsh's more decided though less cautious expression, our being "irresistibly impressed with the identity and indivisibility of the substance mind," if at all admissible, which, however, speaking merely philosophically, we think it is not, ought to have been conjoined with a parallel assumption as to the essence of matter in any of the compound substances presented to our observation. But, really keeping in view our entire ignorance of either of these essences, and making no allusion to them whatever, analysis in the case of physical science may be held as not more real than that in mental; in short, it is virtual in both, or regards the relations in which objects necessarily appear to, or, according to the constitution of our nature, are considered by us. We see no difference in this respect between the science of mind and of matter, each of them having relation to the being or beings by whom they are prosecuted.

Real & Virtual Analysis.

States of Mind analysed.

Such seems to have been the opinion of Dr Brown; for, says he, (Sect. 2.) "The knowledge of the quality of matter, in the whole wide range of physics, is not itself a phenomenon of *matter*, more than the knowledge of any of our intellectual or moral affections; it is truly, in all its stages of conjecture, comparison, doubt, belief, a phenomenon of *mind*; or, in other words, it is only the *mind* itself existing in a certain state. The inanimate bodies around us might, indeed, exhibit the same changes as at present, though no mind had been created. But science is not the existence of these inanimate bodies; it is the principle of thought itself variously modified by them, which, as it exists in certain states, constitutes that knowledge which we term astronomy; in certain other states, that knowledge which we term chemistry; in other states our physiology, corporeal or mental, and all the other divisions of science." Our objection, then, is, that the analogy spoken of by Dr B. is closer or more complete than he admits, not because of the analysis, in the case of mind, being real and not virtual only, but because the analysis in the case of matter is virtual and not real. Analysis, in either case, is merely one of the modes of practising observation, or treating objects so as that we may discover their relations; a truth, of which, Dr Brown, diligently and sagaciously following Bacon, was well aware. "All physical science," says he, "whatever may be the variety of objects, mental or material to which it is directed, (he might have added, however attained) is nothing more than *the comparison of phenomena*, and the discovery of their agreement or disagreement, or order of succession. It is on observation, therefore, or on consciousness, which is only another name for internal observation, that the whole of science is founded, because there can be no comparison without observation of the phenomena compared, and no discovery of agreement or disagreement without comparison. So far, then, as man has observed the phenomena of matter or of mind, *so far, and no farther*, may he infer with confidence the properties of matter and of mind; or, in the words of the great primary aphorism of Lord Bacon, which has been so often quoted, and so often quoted *in vain*, "Homo, naturæ minister et interpres, tantum facit et intelliget, quantum de naturæ ordine re vel mente observaverit; nec amplius scit aut potest."

To proceed, Dr Brown, in opposition to the prevalent opinion, probably of the vulgar as well as of the older metaphysicians, namely, that ideas and feelings are something different from the mind itself, maintains, that our sensations, perceptions, thoughts, and feelings, are in reality the mind itself existing in different states, and that, consequently, it is the business of the philosophical inquirer to analyze and arrange them.

Now, one grand physical distinction between them is very obvious. Some of them arise in consequence of the operation of external things, and others in consequence merely of previous feelings of the mind itself. They may be arranged, accordingly, into EXTERNAL AFFECTIONS and INTERNAL AFFECTIONS; and these, again, are capable of subdivision, the former very easily, according to the bodily organs affected, or the external senses and other portions of our corporeal system, and the latter into intellectual states of the mind and emotions. Farther, these intellectual states are subdivided into *simple suggestions*, "which afford us mere copies of former feelings, and *relative suggestions*, which develope a new order of states of mind in our feelings of relation." Here, it is proper to state, the term *suggestion* is used to express "the general fact of the rise of the feelings in succession, without involving any hypothesis as to the processes of former association, or any other circumstances that may be justly or erroneously supposed to connect them." Another remark is necessary in regard to consciousness, of which Dr B. entertained an opinion different from that of Dr Reid, Mr Stewart, and some other metaphysical writers. According to them, consciousness is one of the intellectual powers, and differs from all the other powers as much as these differ from each other. Dr B., on the contrary, holds it to be merely a general name expressive of the whole variety of our feelings, so that, when we speak of being conscious of a feeling, we mean only that we feel in a particular manner, and not that our mind is in two states, namely, one of consciousness, and another of a feeling distinct from it. If this view of consciousness be correct, it follows, as Mr Welsh has noticed, that between the simple notion of self, consciousness, and memory, there is no difference, save that in the first our attention is chiefly directed to the permanent substance itself,—in the second, to the present,—and in the third, to the past object.

External & Internal Affections.

The class of external affections comprehends all those states of mind which are the direct consequents of certain affections of the nervous system, or what are usually termed *sensations*, and all other feelings originating in affections of portions of our sensitive frame, the most important of which, according to Dr B., are our *muscular feelings*. The appetites are classed under the less definite affections of sense, together with the painful feeling of anxiety from impeded respiration, and also other morbid feelings. The external affections, yet spoken of, are such as we rarely think of referring to particular organs, though we know them to depend on parts of our nervous frame. Besides these, there are more definite states of mind resulting directly from bodily changes, and usually referred to external causes as their excitements, as sensations and perceptions, terms used in relation to corresponding external qualities. Speaking of these, in general, and alluding to the organic change which intervenes between the presence of an external object and the consequent sensation, Dr B. uses language which has some resemblance to that of the phrenologists. "The brain and its appendages, though specific names have been given to some of them, may be regarded as *one* great *sensorial organ*, of which portions are diffused over various parts of the body, particularly on the parts termed organs of sense, but which still, however widely and distantly spread, are in perfect continuity with the whole mass. Of this great organ, an affection of some sort is consequent on the presence of certain external objects at the parts of it which terminate in the organs of sense, and is followed by a corresponding change in the state of the mind; but the nature of the change by which the state of the sensorial organ in sensation differs from its state before sensation, it is absolutely impossible for us, with our present limited knowledge, to determine, or even to conjecture." This, it will soon be seen, is not the only approach towards the doctrines of the new philosophy to be found in the labours of Dr Brown. In the meantime, it may be stated that his *external affections* correspond to, or comprehend rather the *external senses* of phrenology; and that, though he refers the feelings of resistance and extension to organic, that is, muscular affections, whereas, according to that system, the first depends on the *organ of weight*, and the other to the organs of locality and size, still, as a writer in the Phrenological Journal, No. 6., mentions, " the nerves of voluntary motion, which are almost ascertained to be distinct from the nerves of touch, may serve as the media of communication between external objects and these internal organs," so that, " there is no opposition on this point between Dr B.'s views and the doctrines of this science."

The first order of the internal affections, namely, intellectual states of the mind, are considered as exhibiting, amid all their specific differences, only two generic diversities, to which, as nearly expressive of them, Dr B. applies the metaphysical terms, *conceptions* and *feelings of relation;* and into these, he thinks, all our trains of thought, excepting the sensations induced by external objects, and certain emotions that occasionally mingle with them, may be divided. Of these, it is said, it is the very nature of the mind to be susceptible in certain trains,—one suggesting another, or having another as its immediate consequent; and these arising in the mind successively, in the absence of the external objects which originally produced the corresponding perceptions. It is admitted that they are capable of being modified by peculiar states of the bodily frame, but, nevertheless, in the present state of our physiological knowledge, it is maintained they must be considered as internal affections of the mind, that is, results of a tendency of the mind itself to exist in one state after existing in some other state. To the phrase " association of ideas," which has been used in reference to such tendency, Dr B. objects, that it limits to our mere ideas an influence not confined to them, and that it seems to imply some mysterious process of union as necessary before the suggestion itself,—an opinion not consistent with the doctrine of those who employ the phrase. It is for the sake of greater perspicuity, therefore, and in order that he might avoid any thing of a conjectural or theoretical nature, that he has preferred the term simple suggestion already mentioned, restricting it entirely and uniformly to " such simple sequences of the similar feelings, exclusively of all notions of relation of object to object that may occasionally arise from them, and be intermingled with them." These simple suggestions, then, may be considered as mere copies or resemblances of former feelings, which begin, continue, and pass away, as it were, separately, without impressing us with any common relations between them; whereas, in other cases, a conception or perception suggests certain feelings of relation, " which, as states of the mind, differ from the mere perceptions or conceptions themselves that have given rise to them, not merely as those perceptions or conceptions appear to differ from each other, but generally as a distinct order of feelings." It is to these last the term relative suggestion has been applied. Dr Brown imputes to imperfect analysis the reference of the intellectual states of the mind, as indicative of these two tendencies, to a greater number of supposed distinct faculties, such as conception, memory, imagination, according to the prevalent system of metaphysical or mental science. Of his remarks on these supposed faculties we shall content ourselves with a very brief notice.

The so-called power of conception, he imagines not to differ more from the power or principle of suggestion, than the power of uttering a single word differs generically from the power of uttering whole sentences. In short, when we speak of a power of conception, or of a power of association or suggestion, all that we mean is one simple tendency of the mind to exist in one state after existing in another state,—the only difference being, that, by the former, we indicate the relation of this state to some external object formerly perceived, and that, by either of the latter, used to express the same internal sequence, we have chiefly in view the relation which the two parts of the simple sequence bear to each other, as directly antecedent and consequent."

Memory, Dr B. maintains, is merely the conception of an object connected with the notion of time; so that, according to him, the feeling of relation to the past is all that distinguishes it from conception, and this, therefore, being taken away, a remembrance becomes a mere conception. From the complex phenomena, designated by the term memory, is inferred a proof or illustration of the tendency of the mind to exist in the state termed a conception, and of a tendency also to exist in the state which constitutes a feeling of relation. So that these phenomena exhibit the two mental capacities of simple suggestion and relative suggestion,—but they do not prove any other tendency or faculty of mind distinct from the general tendencies whence we have all our conceptions and feelings of relation. Imagination, deemed by the metaphysicians a distinct faculty of mind, will also, Dr B. believes, when fully analysed, be found capable of resolution into simpler elements; and its phenomena he holds to be proofs of those general tendencies of the mind by which we are susceptible of simple suggestion, of relative suggestion, and of desire. But for the process by which he deduces this opinion we must refer to his own work, as well as for his reasoning concerning habit, which Dr Reid asserts to be an original principle of the mind. In concluding his observations as to these supposed distinct faculties, Dr B. allows, that the words used to denote them are very convenient for designating peculiar complex states of mind; and that all that is necessary in using them is, that we should be fully aware of the nature of the simple influence or concurring influences of which they are modifications.

States of Mind.

We have now to speak of the feelings of relation, which constitute the second division of the intellectual states. They are classed under relations of co-existence and relations of succession, differing in this, that the former do not involve and the latter do involve the notion of time. Of relations of co-existence, the whole possible variety is conceived to be referrable to *position*, comprehending *distance*, *resemblance*, or *difference*, *proportion*, *degree*, and *comprehensiveness*, in none of which is the idea of time included. In this department fall to be discussed several of the most important or curious questions in metaphysical science, particularly relating to general notions and terms, for which the reader must have recourse to Dr B.'s Lectures. As to relations of succession, it is enough to mention here, that they comprehend the notion of time, are relations either of *casual* or of *invariable* antecedence or consequence, and involve the topics of what are usually called cause and effect, and power.

The remaining order of our feelings, namely, those called emotions, is treated of under those terms, and according to those states of combination, in which they are usually spoken of, and exhibit themselves in the ordinary intercourse of mankind, such as cheerfulness, melancholy, wonder, and langour, beauty, sublimity, deformity, the ludicrous, of which we do not purpose taking any farther notice.

Hitherto we have said little, except incidentally, of several laws, which, though denominated secondary, materially modify the succession of our thoughts, and which, therefore, Dr B. considers of equal importance with those principles of association, resemblance, contrast, and former proximity, treated of by metaphysicians. According to him, many of these secondary laws of suggestion frequently concur in relation to the same object; but, whether operating singly or together, their influence is necessary in every case for determining suggestion to one subject rather than another, "when many objects might equally be suggested, in conformity with the relations that constitute its primary laws." They are nine in number, of which very briefly. 1. Other circumstances being the same, one suggestion will take place rather than another, according to the longer or shorter continuance of the original feelings, when they originally co-existed or succeeded each other: 2. As the original feelings were more or less lively: 3. As they have been more frequently renewed in the same order: 4. As this order of sequence has been more recent: 5. As the primary conception in the sequence has co-existed less with other conceptions, or other feelings of any kind, that have no peculiar connexion with that which is suggested: 6. Constitutional differences in individuals give a positive direction to the suggesting principle, and these are some of the differences which are characteristic of genius, temper, or disposition: 7. There are also less durable differences or peculiarities which tend to modify the laws of suggestion, such are the pleasing or painful emotions experienced at various times and seasons: 8. So also are there states of body, as those of health and sickness, repletion, hunger, or abstinence, the effects of intoxicating and other substances, all of which influence the suggesting principle: 9. and, lastly, Certain general habits, superinduced by various circumstances peculiar to individuals, have likewise considerable effect on the same laws.

Peculiarities of Dr Brown's System.

The chief peculiarities of Dr Brown's system, then, may be easily summed up. 1. There are two objects in view in the philosophy of mind, namely, the analysis of the complex phenomena of thought and feeling, and the arrangement of those phenomena in the regular order of their sequence, as causes and effects. In short, there is a physiology of mind, as well as a physiology of matter; and both are to be prosecuted or studied in the same general manner, that is, according to the principles of the inductive logic. Here, perhaps, it may not be improper to hint the possibility of this view of the subject, and the very title of his essay, together with several original or curious remarks, having been suggested to Dr Brown by the production of a writer scarcely known among metaphysical authors, namely, Human Nature Delineated, or the Limits of Human Knowledge Defined, by J. Stephens, M. A. (London 1761,) the copy of whose work, now in the possession of the individual who has drawn up this summary, has the autograph signature of the late worthy professor. It is not at all designed, by this remark, to imply any thing to his disparagement,—for, indeed, such a work as that of Stephens, however excellent and forcible some of its contents, could have afforded very little aid to so fertile and industrious an intellect as that of Dr Brown. But, in the history of literature, and, above all departments, in that of metaphysical disquisition, it is of importance to the subject itself, and the advancement of science, to ascertain, if possible, from what sources, and in what mode, any glimmering of light has been received. One or two short quotations from Stephens are all that can be inserted in this place. His preface contains a spirited reproof of the errors and dogmatism to be found among both theologians and philosophers, especially such as have pretended to explain the nature of God and the mind. In opposition to these, and to the common procedure in regard to this science, he says, "Nothing can be more effectual to separate the false notions from the true, and to go to the root of error, than to turn our eyes inward, and contemplate impartially on what passes in the mind, from its infancy to its maturity; hereby it will not be very difficult, and by this means alone it is possible, to discover the true limits of human knowledge,—how far it is real, and when or how it begins to be only fantastical. This is the method I have taken in the following treatise. I have grounded my assertion on the phenomena of nature; I have advanced nothing but what experience has dictated, and have endeavoured to render what I have advanced intelligible. To speak the truth, therefore, though it may seem to the generality of mankind a paradox, our knowledge on various subjects, and particularly on those I shall hereafter treat of, must be superficial to be real. Such is the state of human nature. The first principle necessary to secure us from falling into the error I have just now taken notice of is, that we should content ourselves with such a knowledge of things as God hath made us capable of receiving." Having in his first chapter enumerated sundry opinions regarding ideas, &c. he says, "It evidently appears, Peculiarities of Dr Brown's System.

that all these opinions are as inconceivable as the subject which they pretend to explain. If we examine all the authors, from Plato down to this day, who have wrote on this head, we shall easily perceive, that they have not in the least contributed to make us better acquainted with the nature and operations of our mind. They have used their utmost endeavours, and done all that human art could do in these cases; but all the knowledge they have acquired (as indeed all they could have acquired, even if they had reached to the summit of human art,) has but contributed to multiply systems of imagination. They have reasoned about the human mind as if they could demonstrate its operations in as plain and familiar a manner as Euclid has done the problems of geometry,—have asserted that they know the nature of it, and have employed much rhetoric to account for all its phenomena. But a person who would reason as reason dictates, will perceive its nature to be as much unknown as ever, and will despair of having any real knowledge about it, except he will be contented with that which may be acquired *a posteriori*. THE MIND OF MAN IS PART OF HIS NATURE AS WELL AS HIS BODY, AS BOTH THESE ARE REQUIRED TO CONSTITUTE HIS WHOLE BEING; THEREFORE THE MIND IS AS MUCH THE OBJECT OF PHYSICS AS THE BODY. Those who pretend to call in metaphysics to account for the operations of the former, are the persons who would confound an imaginary system with a system of real knowledge. Let us, therefore, content ourselves with making proper remarks upon his mind, to mark well its growth, and the progress it makes, and the qualifications it acquires from the first of its existence to maturity."

2. The next peculiarity in Dr B.'s system to be noticed, is the fundamental proposition that the thoughts, feelings, and so-called powers of the mind, are not different from the mind, but are in reality the mind itself existing in certain states. How exceedingly different this view of the subject is from the commonly received doctrines of the metaphysician, must be very apparent to all who have taken an interest in the science of mind. A single remark is all that need be given here in regard to the difference. While the notion was entertained, that the faculties of the mind, to use the established phrase, had, as it were, a distinct or separate existence,—and while, in alliance with this notion, our ideas were conceived to be something intermediate between our minds and external objects, it seems impossible that any ingenuity or industry should have imparted to this department of knowledge more than a faint semblance of truth, and a very partial correspondence with the phenomena of human nature. That the errors now alluded to vitiated the early metaphysics, must be well known to those who have ever, even in a slight degree, subjected them to examination; and that the writings of Locke and of subsequent authors, though aware of their existence and evil consequences, are occasionally tinctured with the prejudices in which they originate or to which they tend, might be easily demonstrated by quotation, were it necessary to do more than recollect the general principles of reasoning and illustration by which they are pervaded.

3. Dr Brown's classification of the mental phenomena is, in many respects, different from any arrangement previously adopted. In the estimation of Mr Welsh, certainly a very respectable authority, "it is the first that ever had any fair pretensions to accuracy and completeness;" but that gentleman freely admits, that, in the progress of physiological science that relates to the functions of the brain, discoveries have been made which affect some of Dr Brown's principles of arrangement in this part of his system;" and that, though he does not anticipate the time when the general division adopted by Dr B. will be superseded, "a different, perhaps a more correct nomenclature (than what he has employed) may be introduced." There cannot be a doubt, that, by these and other expressions and allusions, Mr Welsh has in view the doctrine and discoveries of phrenology, in the substantial truth of which he has avowed his own belief. Indeed, there is a correspondence between some of the principles of Dr Brown's system of mental philosophy and that science, of which it would have been unpardonable in Mr W. not to have taken notice, whatever his sentiments regarding the latter had been. A few remarks, chiefly extracts, on the extent of that correspondence, and the possibility of reconciling what may be reckoned the primary principles of the two systems, as attempted by Mr Welsh, are perfectly in accordance with the object of this essay.

Correspondence of Dr B.'s System with Phrenology.

The *external affections of the mind*, it has already been mentioned, correspond to the *external senses* of phrenology. Again, the *knowing and reflecting faculties of this science*, correspond nearly to the *intellectual states* of Dr Brown, while his *emotions* seem comprehended in the *propensities and sentiments* of phrenology. Farther, as is observed in the Phrenological Journal, (No. 6.) "the reader will at once perceive that Dr Brown's simple suggestions" correspond very closely with the knowing faculties which perceive and remember objects that exist, and their various qualities; while his "relative suggestions" answer to the reflecting faculties of phrenology, viz. causality, comparison, and wit, the sole function of which is to distinguish abstract relations." Several of his *feelings of relation* correspond to the phrenological divisions, as his resemblance with comparison and difference with wit. "In the enumeration of the emotions," says the Journal, "Dr B. differs in many important particulars from phrenology. In phrenology, the primitive feelings, connected by nature with particular parts of the brain, are the leading objects of investigation, and the "complex conditions, in which they generally exhibit themselves in the world," are discovered by observation of the combination of the organs in different degrees of relative size in different individuals. For example, Dr Brown, under the head of *immediate emotions*, treats of "Cheerfulness and Melancholy." The phrenologist finds no organs for such emotions; but he discovers individual organs of benevolence, hope, and cautiousness; and observes, that persons in whom benevolence and hope are large, and cautiousness moderate, have a natural tendency to cheerfulness; and that those in whom those organs are small, and cautiousness very large, have a natural disposition to melancholy." "In consequence," it is added, "of Dr

Correspondence of Dr B.'s System with Phrenology.

Brown not having arrived, in many instances, at the primitive emotions and intellectual states, and being unacquainted with the existence of separate mental organs, and the effects of size in the organs on the power of manifestation, his representation of the mind resembles rather an elegant and magnificent statue, than a living human being; it has comparatively few capabilities of working; it cannot so easily be transported to the ordinary walks of life, and rendered useful, as the phrenological system; but still, when the method of its construction is kept in view, its close approach, in many points, to nature, is a wonderful monument of Dr Brown's depth, ingenuity, and comprehensiveness." Very similar is the language of Mr Welsh:—"The time is long gone by since this subject (the discovery of Dr Gall concerning the connection of cerebral organization with intellectual and moral manifestation) could legitimately be treated with ridicule; and the absurdity of employing this weapon against it will appear still more obvious, when I mention that many of Dr Brown's doctrines correspond, in a very remarkable degree, with the new system. I am convinced that the time is speedily approaching, when, great as Dr Brown's merits in other respects will always be allowed to be, his greatest merit will be seen to consist in the near approach that he has made to many of the doctrines of phrenology, without the aid of the instrument that phrenology presents." "An acquaintance with the system of phrenology is most valuable to those who purpose to peruse the works of Dr Brown; and certainly there are none who will value Dr Brown's discoveries more than the phrenologist."

As to the compatibleness of the leading doctrine of phrenology, namely, that different portions or organs of the brain are connected with the primitive feelings of the mind, with the fundamental principles of Brown's system, namely, that the powers, thoughts, and feelings of the mind, are not different from the mind, but only the mind itself existing in different states, Mr Welsh expresses himself in an explicit and very cogent manner. The substance of his remarks may be thus condensed. The introduction of cerebral organs in no degree affects Dr Brown's doctrine,—for neither these organs, nor any state of them, are the mind, which is believed to be simple and indivisible. The only difference which the discovery of the connection between these organs and the mind can occasion, is, that, instead of the feelings and thoughts being considered the relations of mind to its own former states, or to external objects, they must be regarded as the relations of mind to certain portions of the bodily organization. For example, the notion of any colour, say that of snow, is a notion of the mind existing in a certain relation to an external object. But there is an intervening step between that object and the mind,—namely, an affection of the optic nerve. Obviously, this does not interfere with the simplicity of the mind; and it is equally obvious, that, instead of an affection of the optic nerve being the immediate antecedent of the notion of colour, another intermediate step might be supposed, as, for example, an affection of cerebral substance, conceived to be the organ of colour, without at all altering the question, or vitiating the position, as to the immateriality of the mind. On this supposition, the notion of colour is a relation of the mind to the organ of colour; and it may be readily admitted, that if that organ were changed in any respect, so as to be more active, larger or finer, the state of the mind would also be changed in a corresponding manner. The same remark applies to all the supposed organs, and their respective faculties, according to the principles of phrenology. Thus, if the organ of casuality be large, there will be a tendency to reasoning, and this tendency is a state of the mind in relation to a material organ, and would have been different had the organ been so. Again, a multitude of organs may affect the mind at the same time, so that a variety of feelings may be experienced; but still the mind is simple, and it is only in relation to these different objects that it is complex. "When we say, then," continues Mr Welsh, "that we have any power, as, for example, of reasoning, we are not to suppose that the power is different from the mind. There is a material organ which is separate from the mind, but the perception of relation is a state wholly mental. One state of the organ may give the perception of relation, another the desire to perceive or discover it, but the perception and desire are both attributes, not of matter, but of mind." Clearly, then, it may be inferred, there is nothing irreconcileable between the principles of the phrenological doctrines and the physiological system of Dr Brown.' To the question, what is the nature or essence of the mind? or, what is the soul when separate from or deprived of the bodily organs by which it manifests itself, neither the system of Dr Brown, nor that of phrenology, affects to give any answer. But it must be quite evident to those who have been at pains to understand the principles of both, that they are alike reconcileable with and confirmatory of all that we are justly at liberty to infer respecting the distinct qualities or different properties of a sentient, thinking, willing, responsible being, and a coherent, solid, extended, figured substance. In a word, they perfectly admit the philosophical inference of Mr Locke, with which we shall conclude this essay. "Every act of sensation, when duly considered, gives us an equal view of both parts of nature, the corporeal and spiritual. For whilst I know, by seeing or hearing, that there is some corporeal being without me, the object of that sensation, I do more certainly know that there is some spiritual being within me that sees and hears. This, I must be convinced, cannot be the action of bare insensible matter, nor ever could be without an immaterial thinking being."

Correspondence of Dr B.'s System with Phrenology.

Phosphorescence.

PHOSPHORESCENCE, a term applied to a property which various substances possess of giving out light under particular circumstances. Those substances, which, after being exposed to light, appear luminous when removed from it, and continue so for a longer or shorter time, are denominated *solar phosphori*; and the luminous appearance in them seems to arise from the light being imbibed, and again slowly emitted.

Phosphorescence in some cases occurs spontaneously, or at least without any existing cause which can be ascertained, as is the case for the most part in animal and in vegetable matters. Some mineral and other substances yield light when their temperatures are raised; others emit light after having been previously exposed for a time to its action without any elevation of temperature. In certain cases it is excited by electricity, but the action of this cause is comparatively rare. It is excited by friction, pressure, or percussion, and is consequently well known, not only in a number of minerals, but familiarly in the case of white sugar.

Without attempting to explain the nature of phosphorescence, we may remark that, as far at least as chemical examinations have yet proceeded, it does not, as the term would seem to imply, depend on the presence, or rather on the slow combustion of phosphorus. The phosphorescence of minerals depends on circumstances quite different from those which cause vegetable substances to give out light. There does not appear to be any analogy in the source of the luminous appearance in minerals and in vegetable matter, and we cannot with any shadow of certainty refer to a common cause the light emitted by animals possessed of this property.

Marine animals, and the insect tribe, are remarkable for emitting light; but, while the property is perhaps universal in the former, it seems to be very limited in the latter. Almost all the species of sea fish become luminous, after they have been removed for some time from the water, and continue to shine for some days. A similar appearance has been observed from the flesh of quadrupeds; which is always apparent before there are any signs of putrefaction, and ceases when that process is fully established. It is an interesting fact regarding this species of phosphorescence, that the matter having the luminous quality may be extracted in a state of solution. If the substance of any marine animal in the phosphorescent state be macerated in a saline solution, as that of sea salt, a lucid ring shortly appears at the surface of the liquid, and the whole becomes luminous when agitated. The luminous appearance exhibited by the water of the ocean is a very striking phenomenon, which has been noticed in another part of this work. (See *Hydrography*, under GEOLOGY.)

Light is emitted by certain insects, and this property has been observed in the genera Elater, Lampyris, Fulgora, Scolopendra, Pausus, Lomulus, Galathia, and Lynceus. The glow-worm, *lamp notiluca*, is particularly remarkable for emitting light in the dark, whence Darwin, in his Botanic Garden, describes it as "a star of his earth and diamond of the night." The light of the glow-worm, which is stronger in the female than in the male, is confined to four points, two of which are situated on each of the two hindermost rings of the abdomen. These and other insects are said to be capable of extinguishing their light at pleasure, and of rendering it for a short time more brilliant than common. The luminous appearance depends on a peculiar secretion, and may even be obtained from its receptacle by compression; it likewise continues to shine for a short time after the death of the animal.

This property is exhibited in different kinds of wood in certain states of decay, and seems to be most frequent in the soft woods, such as willow, hazel, and birch. But it is of short continuance, and seems to be limited to some particular stage of the progress of decay. The phosphorescence of minerals by heat is very generally known. The experiments of Dessaignes in France, and those of Brewster in our own country, have afforded information with regard to the numerous circumstances by which it is excited or modified, and the minerals in which it exists. The list of minerals in which phospherescence existed, was first enlarged by Mr Wedgewood, whose experiments were performed by reducing to powder the substances under trial, and shewing it on a plate of iron heated just below that of visible redness, and removed to a dark place.

Those minerals that emit light, when rubbed upon each other in a dark place, are said to be phosphorescent by friction. Those that give out a light of different colours according to the nature of the mineral on being reduced to powder, and exposed to heat, are said to be phosphorescent by heat. A brilliant light is given out by some minerals when they reach a certain temperature under the action of the blow-pipe.

Solar phosphori can be prepared by artificial processes;—as the Bolognian phosphorus, in which the property is formed from sulphate of barytes reduced into a paste with mucilage, and calcined in contact with gnited charcoal; and Cauton's phosphorus, which is prepared from calcined oyster-shells mixed with sulphur and exposed for about an hour to the heat of ignition in a crucible.

Much diversity is apparent in the degree of phosphorescence. Some substances shine so feebly, even after exposure to solar light, that to perceive it the eye requires to be rendered sensible by previous darkness. Others are illuminated by the mere light of day, and a few become phosphorescent when exposed to the light of a lamp. The light given out is frequently yellow or red, and some exhibit the prismatic colours.

# PHRENOLOGY.

**Definition.**

THIS name is now almost universally given to that science, of very recent origin, and singularly important claims, which treats of the faculties of the human mind, not, according to the manner of the metaphysicians, in the abstract, and separately from all connection, real or supposed, with the corporeal structure, but in conjunction with, indicated and manifested by, certain portions of it, considered as their instruments or organs. The name itself, though in strict etymology liable to objection, is, as defined, very explicit and comprehensive. It is derived from two Greek words, signifying, metaphorically, the *mind*, i. e. the understanding, and the affections, and *discourse*; and might, with perfect propriety, be employed to designate any doctrine which professed to set forth and explain all that is or may be known concerning our mental constitution, in alliance, as beyond all question it is, with the nature and mechanism of our bodies. The attempts, therefore, to pervert and scandalize the name of this system, in which so many of its opponents have indulged, must be ascribed to any thing else than a conception of the objects of that system, or a conscientious desire to ascertain whether it be true or false. Different, perhaps, in origin, but equally unjustifiable, are the charges of materialism, immorality, and irreligion, which others have adduced against it, not, after examination of its tenets, by any means, but in entire ignorance of them, and in the very face of assertions and conclusions of an opposite nature, and the most obvious cogency. This remark is essential in the very outset, in order to repel the prejudices which the miserable wit of these attempts, and the perversity of these charges, have excited. Let us come to the discussion of the subject, not hood-winked by individuals, whose pride is committed in the defence of established opinions, be they right or wrong, who earn their bread by abusing the public mind, and take delight in vilifying the honesty which they cannot imitate,—but with the fearless conviction, that the interests of truth are best promoted by free enquiry, and are endangered no less by wilful blindness than by unprincipled dogmatism.

The mind, in regard to the nature or essence of which nothing whatever is predicated in this system, manifests a plurality or variety of faculties, that is, powers of feeling and thinking; and these faculties or powers, for the existence of which we have the joint evidence of consciousness and observation, and the aggregate of which constitutes the whole of what by these means we know of mind, are considered to be primitive and original, not the result of any process of training, external interference or influence, on the part of man, however thereby modified; but the workmanship and gift of the Author of nature, as peculiarly and exclusively as the members of our corporeal systems. Some of these faculties are common to mankind and the lower animals. Such, at least, seems the fair inference from the correspondence between their modes of manifesting themselves, their objects, and uses, to which may be added, though in the way of anticipating, the correspondence so far of bodily organization. Others are found only in man, who is thereby not only peculiarly distinguished above all the inhabitants of this earth, and fitted to maintain the pre-eminence, but likewise incited to acknowledge and venerate a power greater than his own, and to aspire after a state of things of which they seem altogether insensible.

**Primitive Powers.**

The primitive faculties or powers, whatever be their number, are found in all the perfect individuals of the species; hence its identity. They are found, also, in different degrees of relative intensity; hence some, and these the most important, of the distinctions among the individuals of the species. The notion of certain metaphysicians, that these faculties of the mind are merely different modes in which the mind exerts itself, is not determined by phrenology; which maintains or assumes, what seems the popular opinion, that they are really distinct, and that, in consequence, they may be, and are possessed in different or unequal proportions by the same individual. It follows from this proposition, for the truth of which an appeal is confidently made to common experience and observation, that the presence or possession of any one of these faculties, in a high degree, affords no warrant for inferring the existence of another, to an equal and corresponding amount. The cases in which all of them co-exist, either in a very high or a very low degree, and at the same time in what may be reckoned fair proportions to each other, are held to be exceedingly, perhaps equally, rare; and the supposition is quite tenable, on the ground of general reasoning, confirmed by extensive enquiry and the history of the world, that few or no individuals either possess them all in perfection, or are entirely destitute of them. An enquiry into the number and kinds of the primitive faculties is surely philosophical, and the determination of them essential to a perfect theory or science of the mind. The metaphysicians have prosecuted the former, and endeavoured to arrive at the latter, chiefly, if not solely, by reflection on consciousness. For example, Mr Stewart. " As," says he, in his Outlines, " all our knowledge of the material world rests ultimately on facts ascertained by observation, so all our knowledge of the human mind rests ultimately on facts for which we have the evidence of our own consciousness." It would be uncandid to suppose, that this eminent author did not scrupulously adhere to the distinction which he maintains to exist between these two great branches of science. But as he resolutely contends for the employment of " the method of induction" to the philosophy of the mind, as essential to its success, and the removal of the scepticism which has prevailed respecting it in

Merit and Fate of Metaphysicians

modern times, it will be exceedingly difficult for an ordinary reader to perceive the propriety of discarding observation as a means of acquiring a knowledge of the facts from which the scientific principles are to be deduced. In reality, the sentence above quoted, which contains the very essence of the common metaphysics, will be found, on a critical analysis, to be perfectly void of meaning in relation to any difference between physical and intellectual philosophy. (See the article PHILOSOPHY in this Dictionary.) Consciousness, it may be admitted, seems to give us some intimations both of the plurality of our faculties and several of their characteristics. Accordingly, they who have directed their attention to it, have been enabled to describe the relations of their own thoughts and feelings, which, upon comparison, have been occasionally found to correspond with those of other men, ascertained in a similar manner. But consciousness is limited to the individual, and, so to speak, surveys the various changes of a single mind only; which, for the reason already mentioned, may differ very materially from every other; and, besides this important circumstance, and supposing there is such a power different from other powers, reflection on it can hardly be exercised profitably except during the quiescence of those powers whose distinctions it is employed to discover. Hence, then, the results of the enquiry thus prosecuted are so exceedingly discordant and unsatisfactory, that the bulk of mankind, intent only on what is practically useful, have almost, as by common consent, left the various systems of the metaphysicians to be enjoyed by their respective founders, without the slightest wish either to understand or profit by them; and they have been confirmed in their infidelity, nay, even prompted to transmute it into infidelity and scoffing, by the multifarious accumulation of works intended for their guidance and instruction. The utmost merit that can be ascribed to the labours of the metaphysicians is, that they have succeeded in detecting some of the modes of activity or exercise, common to the primitive faculties, or some of those general principles in which they agree. But, unfortunately, going no farther in their analysis, they concluded that these modes or principles were the faculties themselves; or, which has probably been more usually the case, proceeding on the notion, however derived, that there were such faculties as those designated by the terms, perception, memory, imagination, and being conscious of phenomena which corresponded *in some measure* with the definitions and description of them, they contented themselves with the prevalent ideas on the subject so much as not even to suspect the possibility of their having erred in the very outset of their investigations. In the remarks now made, we have a solution of two facts, in the history of the science of mind, which seem almost inconsistent, and, certainly, in any other way, are very difficult of reconciliation,—namely, the nearly universal concurrence of opinion, on the part of those who laboured in it, as to the existence of certain powers so denominated, and the amazing discrepancies in the relations given of their respective natures and properties. From the ingenuity, the intellectual vigour, and the singular industry of many of the cultivators of metaphysics, it is impossible to doubt, that, had they been apprised, no matter how, of the number and functions of the primitive faculties, and been aware of their connections with and dependencies on certain portions of our bodily constitution, they would have been enabled, with half their toil, to erect a system of science, which, while in point of evidence not inferior to any branch of physics, is in importance to the condition and hopes of mankind ineffably superior to all of them. "But," says Bacon, "if men have failed in their very direction and address, that error will never by good fortune correct itself." It is due to the writers on metaphysical science, particularly if those on ethics be comprehended, to state, that there is scarcely a single primitive faculty, ascertained by phrenology, of which we shall not obtain some information from them, though, unhappily, for the reasons already assigned, what is admitted as an original power in one, is denied to be so in another, and hardly any two of them agree as to either their number or their nature and use.

Labours of Novelist, &c characterized.

The writings of the novelist, the dramatist, and the poet, may be also successfully consulted for information respecting the primitive faculties; and plainly, because it is their province, either to represent mankind as they find them in the intercourse of the world, or to invent characters which, in order to excite sympathy, must bear some of the well known lineaments of our race. Much of the interest of these writings depends on their correctness and fidelity in this respect; and, assuredly, no work of the kind will be of great and permanent reputation which does not strictly maintain the truth of nature. But, profitable or amusing as they may be, they do not in general claim regard by any systematic qualities,—and are necessarily much more occupied in the description of phenomena and the narrative of events, than in deducing the principles and expounding the laws of the mind. They are, consequently, rather to be had recourse to for illustrations of what may be otherwise established in this branch of philosophy, in short, for examples of the operation of the primitive powers, than entitled, by their logical procedure and scientific consequence, to the respect and deference of the student. A similar remark is applicable both to the productions of the historian, and, aside from the paramount authority of revelation, to the discourses of the practical moralist and theologian.

There is another class of inquirers into the constitution of the mind, to whose mode of research a very different objection is to be urged,—those, namely, who, giving credit to the very early and almost universally admitted notion, that the *brain* is that portion of our bodily structure with which the mind is more immediately connected, have imagined they could ascertain its functions by means of the knife in the dissecting room. No procedure could have a more incompatible object, or prove less successful. The appearances of that organ have no affinity whatever with the mental phenomena: not a single trace of thought or feeling is discernible in it; nor, in reality, does it furnish any indication, either of a single primitive faculty, or of any of the

Result of Anatomy Appreciated.

purposes to which, there cannot be a doubt, it is with unerring skill adapted. In short, judging from what is past, so far as anatomy is concerned, the uses or functions of the brain may be expected to be for ever unknown. But, aside from the testimony of experience as to its inefficiency, there is a fundamental reason in the nature of things for abandoning all hope from it as a direct means of elucidating either these functions or the functions of any other organ, however important, after they are discovered, its aid may be, as a test of the truth of any physiological explanations, which must be rejected if inconsistent with the facts disclosed by it. "Strictly speaking," says Mr Laurence, a very competent authority in these matters, and not a phrenologist, "structure alone is learned by dissection: the vital properties of organic textures, and the functions of organs, are found out by observation. We have the most perfect anatomical knowledge of the spleen, thymus, and thyroid gland; but their offices in the animal economy are wholly unknown. What organ has been more carefully dissected and studied than the brain? yet the respective offices of its various portions have not been discovered." Decided as this language is, Mr Laurence concurs, with ninety-nine out of a hundred, who ever thought of the subject, in the unqualified admission, that the brain is "the organ or instrument of knowledge and reflection, the part by which we feel, perceive, judge, think, reason; the organ or organs connecting us with the external world, constituting the moral and intellectual department in our economy;" and, moreover, he says, "the truth, that the phenomena of mind are to be regarded physiologically, as the functions of the organic apparatus contained in the head, is proved by such overwhelming evidence, that physiologists and zoologists have been led, almost in spite of themselves, to shew their belief of it, by the great attention they have paid to these parts."

Importance and Use of Brain Admitted.

The expression here used in regard to the phenomena of the mind, namely, that they are "the functions of the organic apparatus contained in the head," need not occasion alarm, as if a dangerous doctrine were insinuated under it. Who can doubt, for a moment, that *thought*, using the term in an extensive sense, is somehow connected with part of his bodily frame? What possible evidence can be given for the existence of thought, so far as human beings are concerned, without such connection? But if, following up the idea thus suggested, it should be inferred, that matter is capable of thought, the answer would be another question: What is thought? and the proper solution of this, while it is an essential barrier against the system of materialism, leaves us at perfect liberty to study all the phenomena of mind, as we actually observe them, that is, manifested by and in dependence on the bodily organs with which the Creator has been pleased to furnish us. Thought, in truth, is only a general term, used by us to denote a class of events or a variety of mental operations; but has no prototype in nature, distinct from the *mind thinking*, any more than the word secretion, digestion, assimilation, or any similar term, not applied to a particular special act or operation, but employed for the purpose of methodizing and briefly expressing what we know or have ascertained of a being exercising the functions so called. Taking this view of the subject, it is quite clear, that, to speak of secretion, digestion, and assimilation, as the functions of certain organs, that is, of portions of matter peculiarly constituted, is just as obnoxious to the charge of materialism, as to admit that thought is the function of any other structure. In short, no more is signified by these terms, than that they are, in the language of philosophy, *powers, properties*, or *qualities* of the respective organs,—understanding thereby, not any thing superadded to these organs, or distinct from them, but merely the organs themselves considered in relation to certain changes invariably observed to take place, when they exist in peculiar circumstances. To put the case in the simplest possible manner,—he is to all intents and purposes as much a materialist who believes and says that fire melts wax, or the sun warms the air, as the individual, who, proceeding on the same principle, namely, the observation of the regularity and constancy of the conjunction, asserts, that the phenomena of mind are connected with the brain. "It is," says the late Dr Brown, "the mere relation of uniform antecedence, so important and so universally believed, which appears to me to constitute all that can be philosophically meant in the words *power* or *causation*, to whatever objects, material or spiritual, the words may be applied." Baxter seems to have preceded Brown in this philosophical sentiment. "Are we," says he, "afraid of renouncing altogether the *active powers* of inactive matter; or of acknowledging too much life and power in nature? I am sure we shall never free our philosophy from absurdity, till we have rectified our notions in this respect." Lest any feel distrust of this mode of reasoning, and entertain suspicion of the doctrinal tenets of a physiologist like Mr Laurence, or any other individual whose profession leads him rather to explore the arrangements of matter than to speculate in metaphysics,—a remark, however, which does not apply to Dr Brown, physician as he was,—it will be proper to adduce some testimonies to the like purport from authors of a very different kind. These might be multiplied so as to occupy all the space allowed for this essay; but, probably, the following, taken, for special reasons, from works of a high moral and theological character, will suffice to remove all dread as to what has now been advanced. It is requisite to state, that, in introducing them here, no support whatever is expected from them to the doctrines of phrenology; and that, on the other hand, phrenology must not be supposed chargeable with their peculiarities either of expression or sentiment.

It is a distinct proposition in Dr Doddridge's Lectures, "that the soul is seated in the brain," which he holds demonstrable by four circumstances not necessary to be detailed. Thus, again, Woolaston, in his Religion of Nature Delineated, though decidedly opposed to the doctrine of materialism, and though he maintains that "that, which in man is the subject or suppositum of self-consciousness, thinks, and has the foresaid faculties, (apprehending, thinking, &c.) it must be something different from his body or carcass,"—nevertheless affirms, "that he doth not find

Testimonies as to the Brain.

himself to think, see, hear, &c. all over, in any part of his body; but the seat of cogitation and reflection he finds in his head, and the nerves, by which the knowledge of external objects is conveyed to him, all tend to the same place; it is plainly something which resides there, in the region of the *brain*, that by the mediation of these nerves governs the body and moves the parts of it, (as by so many reins and wires,) feels what is done to it, sees through the eyes, hears through the ears," &c. Grove, equally opposed to the doctrine of materialism, and noted for his piety, does not scruple to allow, in his System of Moral Philosophy, Lond. 1749, that the brain is "the great instrument, or condition rather, of thought and contemplation." The excellent author of the Procedure, &c. of the Understanding, namely, Bishop Brown, who contends strenuously for the distinct natures of spirit, soul, and body, says, "If the pure spirit within us could think and reason *independently* of all material and bodily organs, we should never be tired with thinking; but, on the contrary, we feel it to be a *labour* of the *brain*, and we find ourselves as much wearied with intense thought as with hard bodily labour." Baxter, than whom a more determined immaterialist never existed, andwho constantly maintains that the soul is not only *forced into a state of union* with its material companion, but also labours under grievous disadvantages in consequence, (see p. 388. of his Enquiry into the Nature of the Human Soul,) argues, that "even the sensory, or that part of the brain to which the soul is united, is external to the soul, *i. e.* doth not belong to it as a part of itself; and, therefore, it may have misrepresentations made to it, by means of this, and yet not be touched or affected in its own nature." Moreover, this ingenious author, while he ascribes all the apparent imperfections of the soul to the state of the mechanism in which it is embodied, and thus accounts for the mistakes made in dreaming, spectral illusions, drunkenness, &c. freely admits, that the phenomena and powers of the mind are discoverable to us, and manifested only, through the organs with which it is united. He explains his views fully in his Essay on Dreaming, a few quotations from which will be found to approach to the phrenological doctrine regarding certain phenomena, though the causes or powers respectively assigned for their production materially differ. It is his object to prove, that the phenomena of dreaming, and the same general principles are applicable to those of other states, cannot be ascribed either to the soul itself, to chance, or to any kind of mechanism,—and his theory is, that "there are living beings existing separate from matter; that they act in that state; that they act upon the matter of our bodies, and prompt our sleeping visions." But, not to discuss this opinion, let us notice some of his explanations. "If a man, under an indisposition of body, from what cause soever it may arise, should see what other people about him do not see, and cannot see; if the object seen is such as cannot be produced without a living spontaneous cause; if he sees it with fright and reluctance, and if it gives him uneasiness and pain, so that the soul itself cannot be this cause; provided, I say, he sees it so, and such, it follows from the reasonin gabove, that a *living intelligent cause* as certainly tampers with his organ then, and makes impressions upon it, and maintains them there, notwithstanding the action of external objects upon it at the same time, as if the same thing happened to him in his sleep only. If the thing seen be of that kind, and hath all the conditions requisite to infer the conclusion concerning a vision seen in sleep, the circumstance of being awake can make no alteration, nor change the necessity of the reasons in the former case." "It requires but a greater degree of the same power to make *delusory impressions* upon the sensory, while real external objects are making *true impressions* upon it, than it would require to make the same impressions while no other impression from external objects is made upon it at the same time. If one is made to see in his sleep a man pursuing him with a drawn sword,—there are certain *proper vibrations* excited in the optic nerves, or such impressions made upon that part of the brain on which the optic nerves act, as if these vibrations were excited in them; and if the same vibrations are *more powerfully* excited in the optic nerves while the eyes are open, than those excited by external objects then acting, the man pursuing with the drawn sword will still appear, even though the eyes are open. And, thus, by easy steps we see, that *dreaming may degenerate into possession*; and that the cause and nature of both is the same, differing only in degree, for dreaming is but *possession in sleep*."—"What is said with respect to the objects of sight is easily applicable to those of *hearing*."—"The more pregnant instances, where people are subjected to illusions of the fancy, and such things as disorder their imagination, generally happen after the brain hath been discomposed with *anger, fear, disappointment,* or other violent passions." The only other passages we shall quote are curious ones. They are taken from a work published at Salisbury in 1776, entitled, A Theological Survey of the Human Understanding, intended as an Antidote against Modern Deism,—and the object of which is undoubtedly a defence of revealed religion. There is added to it a Psychological Stricture, "the intent of which is chiefly to evince, on the principles of reason, that the souls of the departed righteous will be hereafter clothed upon with glorified bodies, rising mysteriously from the dissolution of their present mortal forms." It is from the latter production we take the following passages: "The nerves are the *only* channels of sensation from without to the *percipient*, whose chief seat is in the brain, whence all the nerves proceed, or rather where they all unite. These are its inlets of credence, and may be called, with great propriety, its windows, through which it sees objects without the body. The office of the brain (in part at least) is to separate that fine subtile fluid from the blood, called the nervous juice, or animal spirits; which being communicated to the nerves, makes them exquisitely sensible of every impression from without, probably by a kind of internal *undulatory* motion, carried on from the extreme parts of the nerves to their interior or correspondent parts in the brain. For 'tis now an established maxim amongst metaphysicians, that every nerve in the dif-

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ferent parts of the body has its *correspondent* in the head; the which, if it be not stricken, there is no sensation from without, how forcibly soever any thing may *strike* on the *exterior* part, as on the eye, the ear, &c.; and as the whole body is crowded very thickly with nervous filaments, that have all of them their tallies or correspondents in the brain, so, it should seem, as though there were in the sensory (including the *percipient*) a kind of *homulus*, or *man in miniature*."—"There is in the brain a constant motion, or intestine pulsation of the correspondent nerves on the percipient,* acquired through habit by impressions from without."—"What these pulsations are *specially*, such, I apprehend, are the ideas they excite, every distinct pulsation of the correspondent nerves on the percipient affording a distinct *idea*. And this, methinks, is evident, from that langour which so commonly follows intense study or thinking of any kind; for, if the nerves be at all concerned in it, as they certainly are, it must be at least their *interior* parts in the brain." "There can be no sense without *contact*, either *mediately* or *immediately* with the thing *perceived*, which implies sensation or feeling, the different degrees of which, in the percipient, as afforded by certain nerves in the head, is what I mean by their *pulsation*. And I judge there is a distinct class or set for the purpose of reflection, because infants, in their earlier time, do not seem to reflect, and yet have the other nerves for ordinary sensation, both exterior and interior; the *reflectional nerves* in the brain being then, I apprehend, in embryo only, but arrive afterwards, in due time, to maturity: and perhaps the number and quality of these in mankind may be one principal difference between them and brutes, who seem to reflect little, and consequently have but few, if any at all, of them. It is said, too, that man hath ordinarily a much larger portion of brain than any brute whatever, not excepting even the ox, though so much larger and stronger in other respects. But instead of reflectional nerves, brutes, and certain birds especially, seem to have some rather of the *itinerant kind*, for they will travel, at times, to amazing distances, without any external guide, that I know of, God only excepted."

Any other testimony can hardly be desired, and, perhaps, we are now perfectly disposed to think with Baxter, that "we should never dissemble any truth for fear of its consequences; that it is directly impossible that truth should have any bad consequences; and again, that no truth, by being known, could have a bad effect on the minds and lives of man."

Lord Bacon was well aware of the value of such inquiries, and has stated in few but very expressive words the kind of information to be derived from the manifest connection of mind and body, to which, however, he seems to have been clearly of opinion, sufficient attention had not been given, up to his time. "As all leagues and amities," says he, "consist of mutual intelligence and mutual offices, so this league of mind and body hath these two parts, how the one discloseth the other, and how the one worketh upon the other, discovery and impresssion. The former of these hath begotten two arts, both of prediction or prenotion, whereof the one is honoured with the inquiry of Aristotle, and the other of Hippocrates. And although they have of latter time been used to be coupled with superstitious and fantastical arts, yet being purged and restored to their true state, they have both of them a solid ground in nature, and a profitable use in life. The first is physiognomy, which discovereth the disposition of the mind by the lineaments of the body: The second is the exposition of natural dreams, which discovereth the state of the body by the imagination of the mind. In the former of these I note a deficiency, for Aristotle hath ingeniously and diligently handled the features of the body, but not the gestures of the body, which are no less comprehensible by art, and of greater use and advantage. For the lineaments of the body do disclose the disposition and inclination of the mind in general; but the motions of the countenance and parts do not only so, but do farther disclose the present humour and state of the mind and will. For, as your majesty saith, most aptly and elegantly, "As the tongue speaketh to the ear, so the gesture speaketh to the eye."—*Of the Advancement of Learning*, Book II.

Dr Gall's mode of Inquiry defended.

The mode of enquiry, then, adopted by Dr Gall, was quite legitimate and philosophical. He did not, as has been asserted, set out with any theory on the subject, but betook himself to observations on the characters of those with whom he associated; and in this process he seems to have been some time engaged, before the idea of connecting their ascertained peculiarities with any arrangement of structure or configuration of the body was suggested to him. The differences in talent and disposition were frequently very considerable, as may be quite easily proved by any individual who chuses to take a similar course, and survey a large portion of his fellow-creatures. Many of them could not be imputed to education or external circumstances, but appeared to have their origin in natural constitution; and, accordingly, though sometimes materially modified by a variety of causes, they were substantially permanent, and generally influenced the whole course of life. One of these specially attracted his attention, by a comparison to his own disadvantage to which it gave rise. This was the facility with which some of his youthful companions learned things by heart, or rote, as it is usually called, and in which they greatly excelled him, though in other respects his inferiors. Entirely independent of any hypothesis, the observation struck him, that all the individuals thus endowed had prominent eyes; and this being recognised by others, to whom the remark was made, he was at last induced to think, that the coincidence was not accidental, but that the two circumstances were somehow or other related to each other. Reflecting on the subject, it now occurred to him, that as verbal memory had thus an external sign, very possibly other intellectual powers might also have visible indications; and these he immediately endeavoured to ascertain, by attentively considering the cases of individuals any way remarkable for either intellectual endowments or moral character. In this manner he found, or conceived he found, external indications of a disposition for painting, music, the mechanical arts, and for certain of the sentiments.

Dr Gall's Progress and Inferences.

But whatever these signs were, it appears that from the first generalizing of his views he ascribed not to the skull, but to the brain, all the influence of the relations of which he was in quest. The writings of the philologists and metaphysicians, to which he afterwards had recourse, afforded him so very little satisfactory information in regard to the brain and the faculties of the mind, and, on the contrary, their contradictory opinions gave him so much trouble, that he resolved to abandon them altogether, and give himself up to the study of nature, by which alone he could hope to profit. In one particular, he could not help perceiving that there was a difference of great moment between his opinions and those of most of the authors whom he had consulted, which threw a considerable obstacle in the way of his determining the external signs of the various powers. Instead of the specific talents and dispositions which he thought he had hitherto observed, these authors spoke of general faculties, such as perception, memory, imagination; in looking for indications of which, as he had done in the other case, he was beset with difficulties and inconsistencies innumerable. The experience of these probably decided the course he was henceforward to adopt, and in the diligent prosecution of which, favoured by many professional opportunities as he was, he soon felt amply recompensed for his previous disappointment. His general principles were few in number, but highly important, and of their truth he entertained an unqualified conviction, arising from observation, aided latterly, so far as it could aid him, by anatomical examination. In these principles, his disciple and fellow-labourer, Dr Spurzheim, who, in the year 1800, began to assist him in his labours, fully concurred: though, on some minor points, both the results of observation and inferences of reasoning, there exists a difference between them. But while this fact, in conjunction with other circumstances, is complete evidence that the system was not a concerted theory on their part, it has had the beneficial effect of prompting their followers to very extensive examination of nature, and, in consequence, to an independence of thought as to the bearing of the phenomena in the highest degree philosophical. The intelligent cultivators of the science freely own, that though its fundamental principles are perfectly ascertained, it is in its infancy as a metaphysical science; that there are portions of the brain, especially towards its base, the functions of which have not been discovered; that some of the earlier opinions, regarding the mental manifestations found conjoined with cerebral developement and external signs, were rather hasty deductions, not confirmed by farther examination; and that sundry modifications may be rendered quite imperative by facts yet to be brought to light. They admit, moreover, that though the system presents unequivocal proofs of the relations subsisting between both intellectual and mental faculties, and the cerebral developement, as indicated by the external configuration and magnitude, so that it warrants certain inferences as to the former from what is observed in the latter, and, conversely, permits conclusions as to structure from known manifestations of mind, yet that it does not sanction any decision as to the degree in which either their propensities or their powers may have been exercised, nor, consequently, any predictions as to the actions of individuals. For a particular description of the brain and nervous system, we must refer to professional works, and the article ANATOMY in this Dictionary; but a few remarks of a general nature are necessary here.

Nervous System described.

The term *Nervous System* may be applied to the whole of that structure, or organization, the phenomena of which constitute the chief distinction of animal above vegetable life. In the superior classes of animals, especially man, the most perfect and liberally endowed, that system consists of the brain and spinal marrow, both secured in bony cases,—the nerves, proceeding from these, and hence denominated cerebral and spinal,—and the organs of the senses. It is with the brain itself we are now chiefly occupied. The substance of the brain is soft and compressible, and seems very similar to that of the spinal marrow and nerves. But it has not the same appearance throughout the whole mass; and the differences in appearance are so remarkable as to have obtained corresponding names;—that of the *cineritious* or *cortical* substance, and that of the *medullary*. The former is of a greyish colour, generally tinged with red, probably owing to the abundance of its small blood-vessels. It is semi-transparent, and seemingly homogeneous. The latter is white, opake, not so vascular as the former,—is of a firmer consistence, and appears to be somewhat fibrous in its structure. In the brain, the cineritious substance is found chiefly on the surface, and the medullary in the central parts. But several differences of arrangement are occasionally met with, and some nearly constant deviations from this distribution. Thus, in portions of the brain, the two substances are mixed together, constituting *striæ*; and in others, especially certain eminences, the internal part is cineritious, and the external medullary. The brain is considered by anatomists as divided, first, into *cerebrum* and *cerebellum*, or greater and less brain,—called also from their positions, anterior and posterior; to which is added, what appears common to both, the *medulla oblongata*, so named from its being a prolongation of portions of the medullary masses of the cerebrum and cerebellum. The cerebrum, obviously, is divided into two *hemispheres* on the upper surface; and if these be turned up, so as to exhibit the lower surface, we may farther divide the observed irregularities into *anterior, middle, and posterior lobes.* The two hemispheres, which exactly resemble each other, in form and substance, are separated by what, from its shape, is called *falx*, or *scythe*, considered a portion of one of the membranous coverings of the brain, which becomes broader, and descends deeper between the hemispheres, as we trace its course backwards. The cerebrum, again, is separated from the cerebellum, also by a membraneous expansion, termed the *tentorium*, only a circular opening being left for the union of the cerebrum and cerebellum already mentioned. The form and internal arrangement of the cerebellum are very unlike those of the cerebrum, although their substance be seemingly of the same nature. This, too, is

Distribution of Brain.

susceptible of subdivisions, but these we need not specify. The surface of each of the hemispheres of the cerebrum is marked by numerous furrows or indentations, which, proceeding in various directions, are styled convolutions, and these are of different sizes in different parts, even in the same individual. Between the two hemispheres, we find the *corpus callosum*, a medullary body, serving as a centre of communication, or great *commissure*, between the hemispheres, and is easily seen on simply dividing them with the fingers. The anterior and posterior extremities are continued into the hemispheres. Underneath, it is the *septum lucidum* which forms the partition between the two *lateral ventricles*, and under the anterior part of which is the communication between these and the *third ventricle*. The lateral ventricles are conceived to communicate near the middle of the *fornix*, which is the inferior arched side of the *septum lucidum*. The *corpora striata* are smooth eminences, somewhat of the shape of a pear, situated at the anterior part of the lateral ventricle; behind them are two other eminences, styled the *thalami nervorum opticorum*; behind these, again, is the *pineal gland*, and beneath it the *corpora quadrigemina*.

The brain diminishes in size as we proceed from the highest to the lowest of the mammalia; it is still farther diminished, and varies in figure and component parts, in birds; becomes less and more simple among the reptiles and fishes; in the molluscous animals, the apparatus is reduced to small ganglia or knots, with a few nerves, and imperfect organs of sense: in articulated animals, we find only a straight cord with a few slender branches; in the more complicated radiated, only some doubtful nervous filaments; and in those still lower, we find neither brain, ganglia, nerves, nor organs of sense. Now, it is quite certain, that, as the organization of this part of the animal system is reduced, or the organic parts are simplified and become fewer, the phenomena of life are so too. No exception to this remark can be pointed out in the whole range of zoology. "The same reasoning, the same kind of facts," says Mr Laurence, "the same sort of evidence altogether, which shew digestion to be the function of the alimentary canal, the motion of the muscles, and various secretions of their respective glands, prove that sensation, perception, memory, judgment, reasoning, thought, in a word, all the manifestations called mental or intellectual, are the animal functions of their appropriate organic apparatus, the central organ of the nervous system." Proceeding on the same incontrovertible idea, Cuvier has been at immense pains to mark this peculiar distinction of external structure in the different classes of animals. His chief conclusions, from a very extensive survey, are the following. "There exist certain relations between the faculties of animals and the proportions of their common parts. Thus, the intelligence they possess appears more perfect in proportion to the volume of the appendix of the *corpus striatum*, which forms the vault of the hemispheres. Man has that part greater, more extended, and more reflected, than the other animals. In proportion, as we descend from man, we observe that it becomes smaller and smoother on the surface, and that the parts of the brain are less complicated with each other, but seem to be unfolded and spread out longitudinally. It even appears that certain parts assume, in all classes, forms which have a relation to particular qualities of animals." He infers, accordingly, that by following out such inquiries, we may hope to obtain some knowledge of *the particular uses of each of the parts of the brain.* No sound physiologist will dispute this position, however he may doubt the accuracy of particular observations, or the logical correctness of the conclusions deduced from them. Mr Laurence has on this subject, and in reference to phrenology, delivered an opinion, which, by the candour and liberality it displays, is strikingly in contrast to the behaviour of certain critics, who, in their zeal for what is presently held orthodoxy, seem to have alike disregarded the merit of individuals and the interests of science. It may very properly be introduced here, as preparatory to what remains to be delivered respecting this system. "Some modern inquirers have gone beyond this general statement: and have ventured to particularize, in the brains of animals and of man, the organ or residence of each propensity, feeling, and intellectual power. I cannot pronounce on the accuracy and completeness of the mental and cerebral survey executed by Messrs Gall and Spurzheim; nor pretend to judge of the exactness and fidelity with which the numerous positions are marked down in their very complete and well-filled map of the brain. They appeal to observation for the confirmation or refutation of their statements; but *my observations are not numerous or varied enough for these purposes.* No one can refuse to them the merit of patient inquiry, careful observation, and unprejudiced reflection. They have performed the useful service of rescuing us from the trammels of doctrines and authorities, and directing our attention to nature: her instructions cannot deceive us. Whether the views of Gall and Spurzheim may be verified or not, our labours in this direction must be productive, must bring with them collateral advantages."

Peculiarities of Brain.

The form of the brain seems to exist before the bone in which it is inclosed; and from this circumstance, besides the distinctions of parts being discoverable in animals whose brain is surrounded with fluid, it is inferred, that these are not accidental, but depend on its internal structure. Every part, discoverable in one hemisphere, has a corresponding part in the other, and hence a strong resemblance may be discovered throughout the lateral divisions. From anatomy, therefore, we conclude that the brain is double; or, in other words, that the lateral divisions are distinct brains, conjoined in function, and having every provision for concurrence and sympathy of action. The cerebrum and cerebellum, or anterior and posterior divisions, have a much slighter connection, and very little of that symmetry and correspondence of parts so manifest in the hemispheres. As to the sensibility in those parts of the brain supposed to be the seat of the intellectual operations, Mr C. Bell justly says, we ought not to expect the same phenomena to result from the cutting or tearing of the brain as from injury done to the nerves. The function of the latter is to transmit sen-

**Mr C. Bell's Inquiries respecting the Brain and Nerves confirm Phrenology.**

sation, that of the former is higher; and this Mr B. is disposed to infer from their being insensible. "If," says he, "in examining the structure of the brain, we find a part consisting of white medullary striæ, and fasciculated like a nerve, we should conclude, that as the use of a nerve is to transmit sensation, not to perform any more peculiar functions, such tracts of matter are media of communication, connecting the parts of the brain, rather than the brain itself performing the more peculiar functions. On the other hand, if masses are found in the brain unlike the matter of the nerves, and which yet occupy a place guarded as an organ of importance, and holding evidently important relations, we may presume that such parts have uses different from that of merely conveying sensation; we may rather look upon such parts as the seat of the higher powers." In some of the lower classes of animals, the brain has no convolutions, and the surface of the cineritious substance is uniform. Ascending in the scale of beings, the extent of this substance is increased, and, to admit of this, the surface is convoluted, the depth of the furrows being the consequence of such increased extension. Accordingly, in man, these convolutions are more numerous, and the furrows formed by them deeper, than in any other animal, or, in other words, the cineritious mass and its extent of surface are greater. The importance of the cineritious matter is pointed out by the fact of every portion of it having a fibre of medullary matter, which runs across and forms a commissure with the corresponding portion on the other side. Taking these fibres to be of the nature of nerves, and serving as "bonds of union betwixt the corresponding sides of the great organ of the mind, we at once perceive how careful nature is to unite the two lateral organs together, and out of two organs to make ONE MORE PERFECT." If this be admitted, it is reasonable to infer, that the portions of cineritious matter discovered in remote parts of the nervous system minister to some important office. Mr B. continues, "I have found at different times all the internal parts of the brain diseased, without loss of sense; but I have never seen disease general on the surfaces of the hemispheres, without the derangement or oppression of the mind during the patient's life." "If I be correct in this view of the subject, then, the experiments which have been made upon the brain tend to confirm the conclusions which I should be inclined to draw from anatomy, viz. that the cineritious and superficial parts of the brain are the seat of the intellectual functions. For it is found that the surface of the brain is totally insensible, but that the deep and medullary parts being wounded, the animal is convulsed and pained." Subsequently to the publication of the work, namely, his System of Anatomy and Physiology, from which these remarks are extracted, Mr C. Bell prosecuted his inquiries into the nature and functions of the nerves, and, beyond all question, established some points in regard to them, which, while they throw light on this difficult branch of physiological science, are perfectly reconcileable with, and tend to confirm the doctrine of phrenology concerning the brain. His remarks will be found in the volume of the Philosophical Transactions for 1821, and are briefly noticed in the first number of the Phrenological Journal. All that we think it necessary to say of his discoveries here is, his having proved that "no organ which possesses only one property or endowment has more than one nerve, however exquisite the sense or action may be;" "that if two nerves coming from different sources are directed to one part, this is a sign of a double function performed by it;" and that "if a part or organ have many distinct nerves, we may be certain, that, instead of having a mere accumulation of nervous power, it possesses distinct powers, or enters into different combinations in proportion to the number of its nerves." The inferences from his discoveries as to the nerves, or the correspondences between them and those of phrenology, are stated in the Journal to this effect. Any inquiry into the nervous system was deemed, and really appeared to be, unprofitable, while it was imagined that all the nerves, like all the parts of the brain, had only one function; for no physiological fact could ever be reconciled to the supposition. But it becomes highly interesting and important, when we admit that each of both of them executes only one function, and that, as we ascend in the scale of being, there is an addition of another part of the brain for every new mental faculty,—and thus alone can we account for the phenomena. There is a nerve of respiration, a nerve of manducation, of the voice, and of feeling, and of taste in the mouth. In like manner, we must admit an organ of benevolence, of veneration, of self-esteem, of amativeness, and of love of offspring, because each of them is distinct from and added to the other. If the whole brain served for all these, then it is impossible that man could have mental faculties different in kind from those of the lower animals, or that one of these latter could possess faculties which another does not, although all have brains, and in all the brain is avowedly the organ of the mind.

Here it is proper to remark, that Dr Spurzheim inferred the distinction between nerves of motion and those of sensation, before it was actually demonstrated by Mr C. Bell. Probably some considerable discoveries are yet to be made in this department of science; and there are certainly sufficient mysteries in sensation, perception, volition, motion, to excite attention in those who have the necessary talents, time, and opportunities for cultivating it.

**Arrangement of the Phrenological Faculties**

In treating of the primitive faculties and their organs, different modes of arrangement and classification may be adopted with nearly equal advantage. Dr Gall seems not to have aimed at any philosophical principle in the order pursued by him; and on this point phrenologists are not all agreed; indeed it is likely they will not agree until very considerable advancement is made in the science. Such is the opinion of Mr Combe, who thus explains his reason for following an order from which the proposer of it himself has more than once deviated. "The principle of Dr Spurzheim's New Physiognomical System, published in 1815, was, as far as possible, philosophical. The organs common to man and the lower animals came first, beginning with the lowest, and ascending. The organs of the moral sentiments were next treated of; and, lastly, the organs of intellect. This ar

Gradations of Organization and Mind.

rangement, however, is not represented as perfect; and Dr Spurzheim, in his French works, has altered it, as he thinks, for the better. I have preserved the old numeration, not on account of its being preferable in itself, but because it will be impossible to arrive at a perfect classification until the primitive faculty, or ultimate function of all the organs, is definitively ascertained. This is not at present the case, and, in consequence, every interim arrangement is in danger of being overturned by subsequent discoveries." For convenience sake, his example is followed here, but with a distinct avowal, on the part of the writer, that the reason for its adoption is far from being satisfactory to his mind. He conceives, in reality, the possibility of an arrangement, which, besides comprehending all that is yet known, shall permit the successive introduction of every just claimant; and, at all events, the objections to which Dr Spurzheim's plans are liable seem to him considerable enough to warrant a call for the speedy coöperation of the most active supporters of the science, in such measures as may be deemed requisite for the establishment of another. The only philosophical, sure, and permanent basis of classification, it appears to him, is presented in the gradations of organization and corresponding function discoverable in zoology and comparative anatomy, beginning with the lowest indication of the living principle, and ending in the highest moral sentiment peculiar to man. In adopting this foundation, Cuvier's work, "The Animal Kingdom, distributed according to its organization," might serve as a guide throughout; and, without discouraging inquirers, it may be safely said, that there is little reason to apprehend the speedy occurrence of such an accumulation of new facts as would render necessary any great departure from a classification so constituted. The essence of the arrangement now proposed, is given in a single paragraph by Mr Laurence. "The number and kind of the intellectual phenomena in different animals, correspond closely to the degree of developement of brain. The mind of the Negro and Hottentot, of the Calmuk and Carib, is inferior to that of the European; and their organization is also less perfect. The large cranium and high forehead of the ourang-ou-tang lift him above his brother monkeys; but the developement of his cerebral hemisphere, and his mental manifestations, are both equally below those of the negro. The gradation of organization and of mind passes through the monkey, dog, elephant, horse, to other quadrupeds, thence to birds, reptiles, and fishes, and so on to the lowest links of the animal chain."

Man differs in kind from all other Animals.

A very respectable writer on zoology, Dr Fleming, though he freely admits that the nervous system contains the organs of sensation and volition, and that there subsists an intimate connection between the mind and that system, and that, distinguishing between instinct and intelligence, the former as common to every organized being, and the latter correlative with the nervous system, calls in question the propriety of classifying animals according to the "characters furnished by it in action." But his reasoning, even if sound, does not apply to the plan here suggested as to the arrangement of the faculties. He speaks, indeed, of numerous instances which are known, where the function is performed without the organ existing which was supposed peculiarly destined to its execution; and this may be imagined, at first sight, to afford a decisive objection. But the answer is obvious. Allowing the instances to be correctly adduced, the only fair inference is that the supposed organs are not the real organs of the functions alluded to, and that farther inquiry, and more cautious induction, are necessary to discover them. Before leaving this subject, we may be allowed to observe, that we entertain no small regret that an individual, possessed as Dr F. undoubtedly is, with many of the talents essential to a philosophical observer, should remain in bondage to a system of metaphysics which vitiates the whole of his speculations on the faculties of the mind. This gentleman, in discussing the question of man's superiority over the brutes, appears to have confined himself entirely to the differences *in degree* observable in the intellectual faculties, the contrivance of artificial signs to express his perceptions, &c. and the greater power of restraining the impulses of his active principles? The first of these causes, according to him, "arises chiefly from the strength of his power of attention, by which he can direct his mind to any subject, until he is satisfied with regard to its qualities or connections; in other words, he can practise abstraction more successfully. Hence all his ideas of reflection are more perfect and extensive, and have given rise to the belief in God, and the corresponding feelings of a piety, of a future state, and the preparation necessary for a blessed immortality." We have no hesitation in saying, that to us this appears to be as erroneous in point of fact as it is illogical in expression. To the second source, as giving rise to tradition, Dr F. ascribes "man's most valuable acquisitions,"--a position which would require to be very materially qualified, and, when so, will be found entirely useless in the argument. Lastly, were we even to grant the third point claimed in behalf of man, namely, the greater power of restraint over his instincts, which, however, we know to be at variance with several facts, we should be disposed to make inquiry as to the cause or source of the superiority; and, in prosecuting it, we have not a doubt of arriving at a conclusion altogether destructive of the hypothesis. Very consistently with his own views of the subject, but certainly not very justly, Dr F. says, "there is evidently a much greater difference between a citizen and a savage, than between a savage and many of the lower animals." "But," he adds, "still we are to bear in mind, the *unlimited capacity* of the one for improvement, and the *limited capacity* of the other." In regard to which explanation we shall content ourselves with a quotation from Mr Laurence: "The human species has numerous distinctive marks, by which, under every circumstance of deficient or imperfect civilization, and every variety of country and race, it is separated, by a broad and clearly defined interval, from all other animals."

We now proceed to the enumeration of the primitive powers and their respective organs, as they are referred to by the casts and plates usually em-

Enumeration of the Primitive Powers.

ployed in phrenology. They are arranged in two orders.

### ORDER I. FEELINGS.

Genus 1.—*Propensities,* or those faculties which do not form ideas, and of which the function is a specific propensity in each, understanding thereby a peculiar tendency, either necessary for the individual, or conducive to the continuance, the safety, and well-being of the species. They are common to man and the lower animals, and are as follows: Amativeness, philoprogenitiveness, concentrativeness, adhesiveness, combativeness, destructiveness, constructiveness, acquisitiveness, secretiveness.

Genus 2. *Sentiments.*—These, like the former, are conceived not to form specific ideas, but to imply a propensity, joined with an emotion or feeling of a certain kind, and are divisible into those which are common to man and the lower animals, viz. Self-esteem, love of approbation, cautiousness, and benevolence, and those which are proper to man only, as, veneration, hope, ideality, wonder, conscientiousness, and firmness.

### ORDER II. INTELLECTUAL FACULTIES.

By this title are designated those faculties which communicate to man and animals a knowledge both of their own sensations and of the external world; or, in other words, the function of which is to make us acquainted with existence and the various qualities and relations of the beings and objects around us. This is divisible into three genera.

Genus 2.—*The External Senses,* viz. Feeling or touch, taste, smell, hearing, and sight.

Genus 2.—*Knowing Faculties,* that is, such as take cognizance of the qualities of external objects, and, accordingly, form ideas; viz. Individuality, form, size, weight or resistance, colouring, locality, order, time, number, tune, and language.

Genus 3.—*Reflecting Faculties,* or those powers which give knowledge of the relations of objects, and constitute what is usually called reason or reflexion. They are four in number, viz. Comparison, causality, wit, and imitation.

These, then, are the primitive faculties or powers hitherto discovered, and the organs of which, or those portions of the cerebral mass with which they are conceived to be connected in the relation of instrument and function, are either established by a wide and legitimate induction, or nearly ascertained and rendered highly probable by numerous but not as yet sufficiently cogent observations. Whether other faculties and their associated organs shall hereafter be added to the list, must be determined by time alone. In the meanwhile, it is quite obvious, that, proceeding on the supposition or the conviction of these having been demonstrated to exist, we can, by means of them, give a very copious and lucid explanation of the diversities in the characters and conduct of mankind. Generally speaking, these diversities depend, not on the mere predominance of one of the powers, but on the proportion which they bear to each other, and the relative intensity in which they are exercised. As to their modes of activity, it is enough to suggest some of the most important laws: First, then, it may be mentioned, the faculties of the propensities and sentiments are usually excited by external objects, according to the constitution of our own nature and that of the world around us. In this case, a feeling, propensity, or sentiment is produced within us, or perceived by us, in a manner quite involuntarily, though the conduct which we adopt in consequence may be subjected to, or influenced by, our will, or by other principles equally a part of our constitution. Secondly, These faculties admit of what may be called internal excitement, or are roused by activity, independently of the presence and operation of external objects. Here, too, our feelings may not be within our control. Often, however, they are so; that is to say, they can be either checked or encouraged; but, in either case, our actions, which, in reality, seldom result from excitement of a single power, are likewise so far dependent on our will, that we must be reckoned, and, in point of fact, we do reckon ourselves, accountable beings. Thirdly, These faculties are capable, though in a manner inexplicable, of exciting one another; and our consciousness of this fact, or, rather our consciousness of having such a power, is, in reality, at once an element in the formation of character, and an indefeasible evidence to our own minds that we are responsible creatures. Fourthly, The term sensation is applicable only to those faculties of which we have just spoken, namely, the propensities and sentiments, and is properly an expression for nothing more than the activity of any of them, however excited, or, in other words, signifies an affection of the nervous system, of which we can give no explanation, and which must be experienced to be understood. In short, to use the language of Dr Brown, it is the mind existing in a certain state of feeling. Fifthly, Some of the faculties, those denominated knowing and reflecting, in place of having or being accompanied with sensations, create what are called ideas, and possess the attributes, or undergo the modes of activity, to which the metaphysical names perception, memory, conception, imagination, and judgment have been applied. Thus, according to phrenology, the first of these, perception, is not a separate faculty, but merely the mind existing in a certain state of activity with respect to one or other of the organs of the knowing or reflecting powers by which it manifests itself. It is considered the lowest state of activity of one of the faculties which form ideas. Memory is reckoned the second, and seems to depend on the excitement in a higher degree, often the voluntary excitement, of one of the same faculties; but it is itself no faculty. Hence the fact, quite inexplicable on the common metaphysical hypothesis, of the same individual possessing a good and a bad memory,—that is, good in respect of the objects of one faculty, and bad in regard to those of another,—and that, too, where there is equal anxiety and wish to have it good. The conception or imagination of metaphysicians is held to be a still higher degree of excitement of those faculties which form ideas,—an excitement which is

Laws of Activity of the Powers.

Application of Phrenological Principles.

sometimes so great as to induce, or be accompanied by, a belief of the actual presence of the objects imagined,—and to this source, accordingly, the phrenologists ascribe most of those illusions and supposed supernatural appearances in which the popular histories of all nations abound. What is styled judgment, in metaphysical books, is deemed to be merely a mode of activity of the reflective powers, and probably also some of the moral sentiments, while engaged in the perception of such relations as agreement and disagreement, cause and effect, transgression and punishment, &c. For farther information regarding these, and some other terms in common use, when treating of the science of mind, the reader will do well to consult Mr Combe's highly valuable Elements of Phrenology; he may also have recourse to the article Philosophy in this dictionary, for hints regarding the correspondence of a portion of Dr Brown's System of Mental Philosophy with the views and observations of Drs Gall and Spurzheim. Two quotations from the former will prove the facility and the felicity with which the principles of phrenology may be employed, both in the solution of metaphysical difficulties, and in the interpretation of peculiarities of character. Speaking of ASSOCIATION, Mr C. says: "The metaphysicians conceive that our thoughts follow each other in an established order of succession, and have attempted to find out circumstances which determine the order and causes in virtue of which one idea introduces another into the mind; in short, by reflecting on their own consciousness, they have endeavoured to discover laws regulating the succession of ideas in mankind in general. Such an attempt appears to the prenologist to be opposed by impossibility. If we place a number of persons on a hill top, say Arthur Seat, overlooking a champaign country, an arm of the sea, and a great city,—one in whom ideality predominates, will be enchanted with the beauty and magnificence of nature; one in whom acquisitiveness is the leading propensity, will think of the profits of the farms and ships, or of the works whose elevated chimneys throw clouds of smoke into the air. One in whom constructiveness prevails, will criticize the lines of the roads, and the architecture of the monuments. One in whom benevolence and veneration predominate, will think of the sources of enjoyment spread out before him, and feel gratitude and reverence to an all-bountiful Creator spontaneously arising in his soul. Now, a metaphysician, who has also visited Arthur Seat, expects, by reflecting on the ideas which the recollection of it calls up in his own mind, to discover laws of association that will enable him to judge of the ideas that will present themselves to the minds of all the other persons here supposed, on its being mentioned in their presence. This expectation, however, is clearly vain; because, the original impressions received by each individual, differed *toto cœlo* from those experienced by all the others; and when the scene is recalled, the associated feelings and ideas of each must clearly be those which his peculiar mind formed at the first aspect of the scene. Association, therefore, expresses only the mental influence of the faculties. Thus, although the organ of causality is the only one which perceives the relation of necessary consequence, it may act in association, or combination with comparison, furnishing illustrations to render the argument clear; with ideality, infusing magnificence and enthusiasm into the conceptions; with tune and imitation, modulating the voice, and giving vivacity to the gestures; and the result will be the manifestation of splendid oratory." "TASTE is the result of the harmonious action of the faculties, generally in at least a moderate degree of vigour. Thus, the most beautiful poetry is that by which gratification is afforded to the higher sentiments and intellectual powers, without the introduction of any extravagance, absurdity, or incongruity, to offend any of them. If ideality is in excess, this produces bombast; if causality predominates too much, it introduces unintelligible refinements; if wit is excessive, it runs into conceits, epigrams, and impertinences. A picture is in best taste when it delights the knowing faculties, reflection, and the moral sentiments, without offending any of them. Thus, if colouring be too strongly or too weakly exerted, the picture will be defective in its shades; if form be weak, it may be out of drawing; if ideality and colouring predominates over reflection, it may be glowing and striking, but destitute of dignity and meaning. If language be overpowerful in an individual, his style will be redundant and verbose; if it be very deficient, it will be dry, stiff, and meagre; if individuality be excessive, he may narrate without reflection; if reflection be too strong, he will reason without premises or facts."

Practical Remarks as to Dimensions, &c.

Each of the faculties is conceived to have its own peculiar organic apparatus in each hemisphere of the brain, so that, as already mentioned, there are two organs for each faculty. These organs, which are possessed by all men in more or less degree, are understood generally to extend from the *medulla oblongata* to the surface of the brain; and the distance in that direction is usually found to bear a relation to the superficial expansion of the organs, so that their respective sizes may be pretty distinctly ascertained and compared. This is a point of practice highly important, because the size of the cerebral parts is demonstratively one of the means by which their functions are to be determined. But size, though absolutely necessary to power, affords no evidence of activity, the degree of which, as depending on various causes, external and internal, must be discovered by other means. It is quite essential to distinguish between these two elements, size and activity; and, probably, the greatest errors committed by many who pretend to a knowledge of the science arise from their confounding them together, or rather their deducing inferences from the former without being acquainted with or making due allowances for the latter. Some practical remarks on this subject will, therefore, naturally be expected.

First, as to the general size of the head. Of the great diversities in this respect every one is perfectly aware, as well as that there are very considerable differences in the forms of heads, some being much larger in certain directions than others, though possibly not more than equal on the whole. The eye and the hand are often quite sufficient to detect those

Remarks as to Dimensions, &c.

differences. We may have recourse to callipers, when great precision is required. In a table of measurements of 20 heads, all of males between 25 and 50 years of age, as taken by Mr Combe, the average dimensions in various directions, including the muscular integuments, were as follows:—

| | Inches. |
|---|---|
| From the occipital spine to lower individuality, | $7\frac{4}{8}$ |
| From the occipital spine to the opening of the ear, | $4\frac{3}{8}$ |
| From ear to lower individuality, | $4\frac{19}{20}$ |
| From ear to firmness, | $5\frac{18}{20}$ |
| From destructiveness to destructiveness, | $5\frac{19}{20}$ |
| From cautiousness to cautiousness, | $5\frac{14}{20}$ |
| From ideality to ideality, | $5\frac{3}{20}$ |

The average in these cases is considered to be higher than that of the natives of Britain generally, several of the heads being larger than ordinary, and none small. This mode of measurement does not indicate the absolute dimensions of the phrenological organs. The length of them, from the medulla oblongata to the surface, is taken better by the instrument recently invented for the purpose, and properly denominated craniometer; and, for the breadth, we must still have recourse to the hand and eye, which, when a good deal exercised, are well known to attain considerable accuracy,—perhaps, indeed, all the accuracy that can be ordinarily described. It would, however, be easy, and might answer some good purpose, to have a graduated flexible quadrant ready to be attached to the instrument at any particular point of the semicircle to which the index is applied.

Some very remarkable differences in the dimensions of different heads, may easily be found in the following manner:—Draw a line, or suppose a line drawn, from the external opening of the one ear, across the middle upper part of the head, and continued to the other ear. This line divides the head into two regions, the *frontal* or anterior, and the *occipital* or posterior region. In some individuals, the larger portion of the head, and a corresponding larger portion of the brain, will be found in the former region; while, in others, the larger portion is in the latter. Again, the directions in which the brain is most elevated may be ascertained by lines drawn from the ear towards the central points of the most elevated portions. The lines thus drawn, and considered as radii, indicate similar differences, that is, a larger portion of brain in one direction, in one individual, than in the same direction in another. Farther, some heads are flat at the top and broad at the sides,—others seem to swell out or expand on the top, but are flat at the sides; a third sort of head is long from the forehead to the occiput, so that a plane, supposed to pass horizontally, would form an oval; while, in another, we find the breadth across, a little above the ears, nearly equal to the dimension from the fore to the back part, so that the horizontal plane would form almost a circle. If, again, we suppose the head divided by a horizontal line passing from the middle of the frontal bone to the upper edge of the occipital bone, we shall find, that, in some individuals, the greatest portion of brain is below the line toward the base of the skull, or what is called the *basilar region*, while, in others, it is above the line, or toward the top of the skull, that is the *sincipital* region. In the greatest number of heads, the occipital and the basilar regions are larger than the frontal and sincipital regions. That such differences are observable is beyond all doubt; and that they are important as indications of corresponding differences of intellectual and moral power, and, consequently, character, will no more be denied by those who are at pains to investigate the relation between cerebral developement and mental manifestation.

Remarks as to Dimensions, &c.

The general inference regarding these considerations may be simply but comprehensively expressed, viz. that the organs of the animal propensities being situate in the lower and back parts of the head, the intellectual faculties in the anterior, and the moral sentiments in the upper, the larger any of them are in proportion to the other parts, or to the whole head, the more do they predominate in the character, and influence the conduct of the individual.

Secondly, as to the size of particular organs, sundry circumstances must be attended to. Thus, if one of them be largely developed, and the neighbouring organs be small, the former will appear protuberant or elevated, so as to be easily discovered; but if the latter be also considerably or equally developed, the general surface will be plain and smooth. Occasionally, an organ that is largely developed pushes neighbouring smaller organs somewhat out of place, in which case the greatest prominence is usually the centre of the larger organ, which, therefore, may be readily ascertained. Bony excresences and risings about the junctions or sutures of the bones, are carefully to be distinguished from the forms and sizes of the organs, as they have no connection whatever with intellectual or moral powers The common or usual forms of the organs, that is, the ordinary external indications of them, are best learned by examining extreme cases, or by comparing together those of excess and defect. In well-harmonized heads no organ predominates, and, hence, there is a general smoothness of surface, which is very apt to perplex a tyro, especially a man who has suffered himself to be abused by the common cant about bumps. Any one bust can only display the appearances of the organs as they exist in a single individual. Examination of many busts, and, still more effectually, frequent inspection of heads, under the guidance of a person well practised in the art of manipulation, is essential to a correct knowledge of the varieties of relative size, and forms of the organs, as presented in nature. It is advisable to commence with those which are large; and the heads of persons in the middle periods of life are preferable. Every science has its elements, every art its difficulties. It is quite absurd to imagine that phrenology is an exception, or to hope to attain familiarity either with its principles or its practice, without being at pains to understand the former or to master the latter. Certain terms are commonly used by phrenologists to express the gradations of size in the organs, as the following, which proceed in an increasing ratio,—namely, very small; small; rather small; moderate; rather full; full; rather large; large; very large. Developements are

Activity of the Organs.

also frequently and advantageously taken in numerals, according to the annexed table, viz.

1.
2. Idiocy.
3.
4. Very small.
5.
6. Small.
7.
8. Rather small.
9.
10. Moderate.
11.
12. Rather full.
13.
14. Full.
15.
16. Rather large.
17.
18. Large.
19.
20. Very large.

Here we have all the degrees from positive deficiency, or negation, to the highest conceivable or ever observed, and at the same time are furnished with the means of signifying those which may be reckoned intermediate between what is indicated by the words put opposite some of the numbers.

Hitherto, in regard to size, one of the requisites to the manifestation of mental power. It is not the only one. A healthy state both of brain and general constitution, especially the former, on which, as is well known to medical men, the latter is greatly dependent, is of essential importance. Of the deviations from it in kind and degree, we need not speak, the subject being properly professional, though beyond a question quite amenable to and forming a part of phrenological science. We have also to speak of the activity of the organs as another and a highly interesting element in the manifestation of the intellectual and moral powers. This varies in individuals no less than the general size of the head, or the relative dimensions of the organs. But its degrees are not appreciable by any obvious distinctions; neither are the causes of the known differences in different individuals, in the same individuals at different times, or in the different organs and faculties at the same time, easily, if at all, discoverable. Besides its usual manifestation in the rapidity with which the faculties are exercised, activity frequently displays itself in the expression of the countenance, or, to speak more comprehensively, in the fluency and celerity of the natural language. Activity sometimes compensates for limited size; and thus, an individual, possessing a small head, or certain organs very moderately developed, may occasionally be found, in some respects, to equal another possessing a larger head, or his corresponding organs in a higher degree developed; but there cannot be a doubt, that when the activity is equal, a superiority of size is accompanied with, or productive of superior power. In point of fact, however, it is questionable, if the degree of activity requisite to great size is either permitted by or exercised in the ordinary condition of society. On the subject of size and activity, Mr Combe has expressed himself at once so eloquently, so judiciously, and so briefly, that it would be injustice, both to the student and to the science, not to quote his words in preference to any remarks that could be hazarded. "The doctrine, that size is a measure of power, is not to be held as implying, that power is the only, or even the most valuable quality, which a mind in all circumstances can possess. To drag artillery over a mountain, or a ponderous car through the streets of London, we would prefer an elephant, or a horse of great size and muscular power; while, for graceful motion, agility, and nimbleness, we would select an Arabian palfrey. In like manner, to lead men in gigantic and difficult enterprises—to command by native greatness in perilous times, when law is trampled under foot, to call forth the energies of a people, and direct them against a tyrant at home, or an alliance of tyrants abroad,—to stamp the impress of a single mind upon an age,—to infuse strength into thought, and depth into feelings, which shall command the homage of enlightened men in every period of time,—in short, to be a Bruce, a Buonaparte, Luther, Knox, Demosthenes, Shakespeare, or Milton, a larger brain is indisputably requisite; but to display skill, enterprise, and fidelity, in the various professions of civil life,—to cultivate with success the less arduous branches of philosophy,—to excel in acuteness, taste, and felicity of expression,—to acquire extensive erudition and refined manners, a brain of a moderate size is perhaps more suitable than one that is very large; for wherever the energy is intense, it is rare that delicacy, refinement, and taste are present in an equal degree. Individuals possessing moderate-sized brains easily find their proper sphere, and enjoy in it scope for all their energy. In ordinary circumstances they distinguish themselves; but sink when difficulties accumulate around them. Persons with large brains, on the other hand, do not readily attain their appropriate place; common occurrences do not rouse or call them forth; and, while unknown, they are not trusted with great undertakings. Often, therefore, such men pine and die in obscurity. When, however, they attain their proper element, they feel conscious greatness, and glory in the expansion of their powers. Their mental energies rise in proportion to the obstacles to be surmounted, and blaze forth in all the magnificence of genius, when feeble minds expire in despair."

Physiognomy, or Natural Language.

The primitive powers have each a peculiar manner of expressing themselves, or possess a natural language. This is the foundation of what is denominated physiognomy, or, more correctly, physiogonomy, so far as it is really scientific, and corresponds, according to the etymology of the term (derived from two Greek words signifying *nature*, and *to know*) with the constitution of nature. It has been defined "the science of judging of the natural character and dispositions of men from the features or lineaments of the face;" but, very properly, it may both be extended to the lower animals and comprehend all those outward and visible marks by which the internal powers and feelings are indicated, and from which, consequently, they may be determined. Several observations on the subject will be found under LANGUAGE and PHILOLOGY; and to these may now be added a general reflection, deducible from, and farther explanatory of phrenological principles. There is no such connection existing between the complexion, or the colour of the eyes, eyebrows, or hair, the magnitude or the form of any of the features or parts of the face, and the cerebral organs, as entitles us to infer any thing whatever

**Physiognomy, or Natural Language.**

concerning the talents and dispositions of men. The contrary opinion, which is that maintained by Lavater and the earlier physiognomists, is founded either on mere conjecture, or on a degree of evidence insufficient to warrant a theory. But, on the other hand, it cannot be doubted, that several, perhaps all, of the features are liable to be so far influenced by the animal, intellectual, and moral powers, as to assume what is usually understood by the term *expression*; and that, accordingly, they may be regarded with some confidence as indications either of what is passing within the mind, or of its settled, habitual, or predominant condition. The experience of most men may be appealed to in support of this truth, as, indeed, there are very few individuals who do not act in the faith of it in their ordinary intercourse with their fellow creatures. To a certain extent, it has often been remarked, we are all physiognomists naturally, and almost without an effort to be so; and that, by diligent and long-continued observation, our powers of discrimination and interpretation may be improved, will not allow of question. But an admisssion to this effect is not comprehensive of any assumption regarding the connection of character with parts of the system by no means physiologically necessary to its production; whereas, it may be asserted, without hesitation, that the existence of a single instance of want of concomitance between the supposed outward sign and the internal peculiarity, as, for example, between a nose of a certain form and intellectual excellence of any kind, is quite destructive of the theory which maintains their relation. On this point, so far as by analogy they are concerned in it, the phrenologists are singular in their devotedness to truth. Shew them one example of the absence of a primitive power, the developement of the respective organ conceived to be allotted to which is obviously present,—or, again, prove the existence of a primitive power, in the absence of, or unaccompanied with, the alleged corresponding organ, no disease nor malconformation coming in the way, and they consent at once to abandon so much of their system. Farther, if the features of the face have no connection,—immediate and essential, it is meant,—with the diversities of character, still less can they be allowed to furnish materials from which the actions and the fortunes of mankind are to be determined, as some physiognomists have strenuously contended. Here it is enough to quote the ingenious and enthusiastic author of Philosophical Letters upon Physiognomy, an English translation of which appeared at London 1751. "The true physiognomist never foretels what a person will, but what he should be. Future circumstances are out of his verge; he only conjectures at the behaviour under them; his discoveries reach no farther than what is inherent in him whom he examines; without offering at what is ascititious. He penetrates into the innate disposition, not the fortune of a man. He declares his genius, but not the province of its exertion; knows the part for which the person is fit, but not that to which he is destined." With this conclusion, qualified in its application to his science, the most strenuous supporter of phrenology will unhesitatingly agree.

**Subordination and Guidance of the Powers.**

The faculties are considered capable of producing actions which are good; and, it is not admitted that any one of them is essentially, and in itself, or by necessity of operation, evil. But, if suffered to assume supremacy, or given way to beyond a certain degree of activity, all of them, with the sole exception of conscientiousness, may occasion a course of conduct, and any of them lead to results, which cannot be justified by the laws of morality and religion, and which, consequently, are improper, injurious, or culpable. Abuses, then, are the consequences of excessive activity or uncontrolled influence. On the other hand, the possession of any faculty in a very low degree, or, supposing this to be the case, the absence of any one, has only a negative effect, so to speak,—that is, permits the operation of other faculties without the restraint or the modifying influence, which, had there been no deficiency, would have been presented. It is held to be the obvious design of the author of nature, that the merely animal propensities should be subordinate to the intellectual powers, and these, again, together with them, regulated and governed by the moral sentiments. The great aim of education ought to be the preservation and perfection of this relative arrangement; and, it is imagined, this is to be accomplished, not by the destruction of any of the primitive faculties, but by proportioning the exercise and encouragement of them to the peculiarities of the combination in which they exist, the circumstances of individuals, the laws of reason, and the principles of religion. Education, to be judicious, therefore, must be as various as the characters of those to whom it is to be applied. Of its efficacy as a modifying power, no sound phrenologist can entertain a doubt, though he may not be able to explain its mode of operation.

The same may be said of the agency of religion, even the system of Christianity itself, the whole tenor of the precepts of which must seem to him to be in direct accordance with what his science discloses in regard to the constitution of man. In reality, so far as it is practical, it appears to him a system of education founded on the most correct knowledge of the primitive faculties of man, to furnish the most suitable directions and impressive motives for their proper guidance, and, by these excellencies, together with the universality of its adaptation, to give satisfactory proof, independently of other evidence, of its coming from Him, "in whom we live, and move, and have our being." With such convictions, entertained as they must necessarily be, however painful or self-condemnatory, with a tenacity equal to that of consciousness, and, if possible, even less to be resisted, assuredly much more palpable, than the inferences of demonstrative science, is it wonderful that the phrenologist should be tempted to consider the obstinate and really malignant opposition which has been raised against the system, on the ground of its evil tendency, as virtually an imitation and a revival of that infuriate spirit which characterized the contemners of truth in former times? Its essence is pride of heart,—an aversion to whatever exposes those pretensions as to knowledge, attainment, and character, by which one man exalts himself above another,—an aversion to be levelled with the lowest

Concluding Commendation.

of his species, as to the source and the merit of his moral and intellectual qualities, and to feel indebted exclusively to his Creator for all that distinguishes his being,—an aversion to be amenable for his thoughts, words, and actions, to the Great Sovereign of the Universe, who will suffer "no flesh to glory in his presence," and to be dependent, for time and eternity, on Him alone, whose prerogative it is alike to judge the world in righteousness, "and to have mercy on whom he will."

That there are difficulties which may very conscientiously be urged as reasons for a temporary suspension of belief in the doctrines of phrenology, no man who understands and supports it will deny. But an admission to the same effect must be made in the case of every other science of observation. To imagine, that such an admission is sufficient to justify universal scepticism, would be more extravagant in degree merely than to maintain that the occurrence of circumstances hitherto unexplained, or of anomalies hitherto not reconciled, is decisive against the claims of phrenology. But it were as uncandid to conceal the objections to which it has been subjected, as it would be uncharitable to think that they neither have been urged, nor can be entertained, without dishonesty of heart or obtuseness of intellect. In regard to these, accordingly, its most intelligent and industrious supporters have generally exhibited a degree of candour, explicitness, patience, and considerate attention, in the highest degree praiseworthy, and the more so as really of rare occurrence in the annals of philosophical controversy. The native effect of this spirit is rapidly realizing in a double sense,—on one hand, the avowed conviction of honourable minds, consequent on deliberate investigation, that there is substantial truth in the science;—and, on the other, the substitution of personal abuse for sound argument, sheer blackguardism and indecency for wit, and the assumption of a hardihood and an effrontery, which very imperfectly veil the consciousness of defeat, and the still more agonizing apprehension of being ere long outvoted, no less by the common sense than the moral feelings of mankind.

The most cautious individual, who, without having previously made up his mind on this science, has candidly perused this elucidation of its principles, must be satisfied, that, however clumsy or circuitous he may at first sight have thought their names, they bear a strong resemblance to what he knows of human nature, and furnish an explanation of many phenomena which will bear comparison with any of the solutions to be found in metaphysical writings. He must admit, therefore, that the system cannot possibly be despicable; and, in all likelihood, it will be his conviction, that there are presumptions in its favour which ought at once to secure it from ridicule, and obtain for it a rank and a title among the natural sciences. In strict philosophy, his admissions would require to be greater. He will not indeed be able—who is able?—to comprehend the nature of the union that subsists between organic developement and mental power,—matter, in any way arranged, and thought or feeling, however diversified; but he must perceive, that, while, on the one hand, the number of the primitive powers, *i. e.* those which cannot with any propriety be decomposed into simpler elements, or referred to any more general principles, is so extensive as to comprehend the most important and commonly observed phenomena of human nature, it is, on the other, quite impossible either to doubt the evidence of the reality of the connexion between the manifestations of these powers and certain peculiarities in the cerebral mass, as indicated by the magnitude and form of the cranium, or to deny that the constancy, the invariable occurrence, of such connection, is a fair reason for inferring their relationship of instrument or organ and function or property. Having arrived at this conclusion, it will seem imperative on him to prosecute farther inquiry into the system; and, particularly, to examine for himself, according to the most approved or usually adopted modes, the concomitances of developement and character presented to him in life. In this case, after making allowance, as in any technical operations, especially at the outset, for inexperience and mistakes, he will infallibly gather strength to his convictions, and ere long attain a freedom of thought as to the proofs and application of the system, which will render him equally independent of authority and indifferent to opposition. If he possess a metaphysical genius, and have formed a habit of reflection, he certainly will not stop here. He has reached, undoubtedly, the threshold of the science,—he has acquired its elements,—and, even at this stage of his progress, the amount of his knowledge, but, still more, the kind of it, must give him a really enviable superiority over the acutest and most sagacious of ordinary observers. But even this is not the climax of its power, the termination of its utility. It is an instrument by which he can lay open all the mysteries of metaphysics; ascertain the correctness of moral disquisitions; detect, so far as they bear on the constitution of human beings, the fallaciousness, or determine the fitness of political principles; analyse the productions of the poet and the artist, with a precision totally unattainable by the common rules of criticism; and, above all things, institute a system of education, appropriate to the individualities of character, encouraging to every excellence, and, therefore, conducive to all the perfection and the happiness of our common nature.

The following table contains a summary view of the phrenological doctrine, and will be found both illustrative of and illustrated by Plates 151 and 152, of which it is unnecessary to give any other explanation. The reader will observe that the table consists of eight columns, and, consequently, extends over the whole of the opening of the book.

⁂ In permitting the insertion of this article, written by an avowed supporter of the system of phrenology, the Proprietor and Editor conceives he has been actuated solely by a regard to justice and the character of his work. As to the truth of the science so called, he must beg leave to be understood as hazarding no opinion whatever, plainly because he has not hitherto been able to devote a sufficient portion of time and thought to the examination of its evidence and merits.

| Names of the Faculties. | Situations and External Indications of the Organs. | Direct Natural Functions and Uses. | Subsidiary Effects and Influences. |
|---|---|---|---|
| 1. Physical or Sensual Love. Amativeness. | The cerebellum. Between the mastoid processes on each side and the projection in the middle of the transverse ridge of the occipital bone. The size indicated by the thickness of the neck immediately below the back part of the head. | Generally known under the name of LOVE, as applied to the specific feelings and desires which subsist between those of opposite sex, and tend to give continuance of the species. | Excitement of some of the other powers, and frequently combined with acquisitiveness and secretiveness; a peculiar degree of interest in all the concerns of the other sex. |
| 2. Love of Offspring. Philoprogenitiveness. | Immediately above the middle of the cerebellum, and over the preceding. When large, and No. 1. is small, the hinder part of the head seems to droop. | Those feelings which are comprehended under the name, or correspond with the nature, of parental affection, or instinctive sympathy and fondness for young. | Kindliness of feeling, distinct from benevolence, towards weak and helpless objects as such. |
| 3. Concentrativeness. Inhabitiveness. | Immediately above the central part of the preceding, but bearing no regular or definite proportion to it. | Not fully ascertained. Probably the power of directing the attention and combining together the action of other faculties. | Probably,—local attachment; simultaneousness of activity, in the exercise of various propensities; and intenseness of character. |
| 4. Adhesiveness. The attachment of Friendship. | On each side of Concentrativeness, outward and upward from No. 2. | Instinctive fondness for certain persons, distinct both from amativeness and philanthropy or general benevolence; the formation of society; reciprocity and intercommunity of thought and feeling. | Attachment to lower animals and to various objects fictitiously assumed into life and fellowship; ardour and warmth of heart towards associates. |
| 5. Combativeness. Disposition to Fight. | At the posterior inferior angle of the parietal bone, or a little behind and stretching higher up than the ear. | Physical courage; the tendency to resist, to attack; resolution to encounter danger and opposition; boldness of spirit. | Intrepidity and undauntedness in argument; resentment and readiness to retaliate. |
| 6. Destructiveness. Disposition to Destroy. | Immediately above and somewhat around, but more towards the back of, the external opening of the ear, so as to give breadth to the lower and back part of the head. | Simply the propensity and desire to destroy, without determining the object, or purposing cruelty. | Keenness of spirit; pointedness of reproof; threatening; the ability to endure distressing scenes. |
| 7. Constructiveness. Disposition to Build or Construct. | That part of the frontal bone which is immediately above the cheek bones, but liable to be varied by circumstances, and to appear higher up. | Generally, the faculty for and desire of constructing,—the kind, manner, and object varying according to other principles. | Fitness for mechanical employments; fondness for combinations, distinct from love of order; tendencies the reverse of those of the preceding faculty. |
| 8. Acquisitiveness. Disposition to Obtain or Acquire. | At the anterior inferior angle of the parietal bone. | The disposition to get, to hoard, without regard to the uses of the objects. It constantly asks for more, and prompts to the attainment of it. | The notion of property; *meum* and *tuum*; much of the constitution, the laws, the government, the commerce, and the wealth of every country; collections; museums; luxury. |

| Physiognomical Expression, or Natural Language. | Uncontrolled, Excessive, or Diseased Manifestations. | Indications and Consequences of deficiency or low activity. | Incidental Remarks. |
|---|---|---|---|
| Peculiar cast of eyes; eyebrows a little drawn down and contracted; expansion of nostrils; mouth gently inclining to openness; general countenance intermediate between languishing and ardour; various attitudes and gestures, practised in the dances of certain savages or semi-barbarians. | Indecency, immodesty, whether in actions or words,—amounting, in some cases, to disgusting or outrageous violations of established manners. | Coldness, apathy, and indifference towards the other sex; celibacy arising from constitution, not principle or want of opportunity. | Generally less in females than in males. Seldom known till puberty. |
| An air of tenderness and sympathy; delicate smile; gentle, not entire, expansion of hands, and openness of arms; soft soothing tones of voice. | Inordinate solicitude and fondness; absurd partiality; pernicious indulgence of the caprices, and obstinate blindness to the faults, of children. | Carelessness towards, abandonment and exposure of, children. | Generally more in females than males. In some animals it operates as an excitement to some other powers. |
| Fixity of eyes, or intentness of look; meditativeness of aspect. | Probably sedentariness, and excessive disinclination to quit places of residence. | Inability to direct attention; vacillancy; distraction of thought. | Seems requisite to strength of character and the production of effect. |
| Openness of look; frankness and kindliness of manner; heartiness and familiarity in the mode of shaking hands, and in other salutations; warmth of embrace. | Unjustifiable partisanship; unfair preference; ruinous postponement of one's own interests, and the sacrifice of principle to advantage or humour friends. | Unsociableness; a recluse and monkish disposition, quite consistent with benevolence. | Generally more considerable in women than in men. With No. 1. it is the foundation of marriage, and society results from it. Sometimes it manifests itself towards inanimate objects. |
| Keenness of eye; rigidity of features; compression and lateral elongation of lips; head a little elevated, and drawn backwards; hands, arms, and whole frame, brought into activity, and a state of preparation for assault; voice a little raised above natural pitch, and somewhat hard. | Unpeaceableness; restlessness; disputatiousness; contumacy; cavilling; litigiousness; scolding; love of fighting; doggedness of temper; foolhardiness; unconvinceableness; downright desperateness. | Timidity; want of spirit; cowardice. | Very conspicuous in the ferocious animals, especially the male. It is quite requisite to heroism and magnanimity. |
| Contracted lowering brows; piercing eyes; mouth a little open, so as to show the teeth; head projected slightly forward, so as to be somewhat before the arms, one of which usually a little elevated and retracted, as if accumulating strength for a blow; voice either very coarse and grating, or shrill and penetrating. | Anger; rage; malevolence; wrath; cruelty; longing to annihilate; blood-thirstiness; savage ferocity; murder; cannibalism; frantic rioting over the dead; insatiable hate. | Softness and want of energy; a tendency to indolence. | Proofs of its existence in man are innumerable. But the exercise of it is by no means necessarily evil; on the contrary, when properly directed, it is the source of much good. |
| Busiedness of manner; apt and facile management of hands; looks somewhat expressive of intentness and curiosity. | Objectless planning; unnecessary and unmeaning contrivances. | Want of dexterity as to workmanship; clumsiness; bungling. | It takes its direction from other principles, but is essential to usefulness in the necessary and excellence in the fine arts. Certain well known animals possess it largely. |
| A sort of longing dissatisfied air, indicated by expanded eyes, moderate contraction of the nose, and very small opening in the lips; head a little projecting; hands prepared to lay hold. | Covetousness; avarice; dishonesty; pilfering; theft; robbery; superfluous, totally useless, and unenjoyable accumulation. | Want of eagerness and enterprise in the pursuit of wealth; sluggish contentment; total unconcern about the goods of life. | The propensity is found in the lower animals. The predominance of it in an individual is probably better overcome by raising some of the other powers than by a direct check. |

| Names of the Faculties. | Situations and External Indications of the Organs. | Direct Natural Functions and Uses. | Subsidiary Effects and Influence. |
|---|---|---|---|
| 9. Secretiveness. Disposition to Conceal. | The middle of the lateral portion of the brain, immediately above destructiveness. | Generally, the desire to suppress the manifestations of other powers, restrain, or conceal them; and probably, in order to this, the desire to discover those of others. | An ingredient in prudence and dignity; circumspection unmingled with fear; the tact to discern time, opportunity, and circumstance; also essential to the discrimination of characters, and hence to *humour, personation, expression.* |
| 10. Self-Esteem. | At the top of the back part of the head, a little above the posterior angle of the parietal bone. | Generally, the feeling or sentiment of self-love. | Those comfortable conclusions respecting one's character, principles, or talents, which impart confidence to one's exertions, and contribute to their success. The desire of power. |
| 11. Love of Approbation. | On each side of the preceding. | The desire of the esteem of others, prompting to a behaviour and actions which are likely to procure it. | Much of the self-denial and amenity of manners observable in polished life; the excitement of various faculties. |
| 12. Cautiousness. | Near the middle of each of the parietal bones. | The emotions of hesitancy and fear; circumspection; carefulness to avoid danger. | Restrains the intensity of other powers; induces a prudential regard to consequences; deliberation, and balancing of circumstances. |
| 13. Benevolence. | At the upper part of the frontal bone. | The disposition to compasionate, sympathise with, and seek the happiness of others; constitutional charity and kind-heartedness. | Much of the active goodness exhibited in human life; mildness of temper; gentleness; cheerfulness. |
| 14. Veneration. | In the middle of the coronal or upper part of the head, a little before the crown. | Those sentiments which lead to adoration of the Supreme Being, and respect towards superiors generally. | Regard for authority, especially that of parents; also for ancestry, rank, whatever is of long establishment or high pretension, independently of the conviction of their real worth. |
| 15. Hope. | On each side of Veneration. | Pleasurable sentiments as to futurity, and the tendency to believe the possibility of attaining what is agreeable to any of the other faculties. | Those feelings which enter into the composition of faith, distinct from the exercise of the judgment, and whether that faith respect the tenets of religion or the ordinary concerns of life. |
| 16. Ideality. | A little above the temples, or nearly along the lower part of the temporal ridge of the frontal bone. | The feelings of the sublime and the beautiful; the tendency to embellish, and to be delighted with whatever is capable of pleasing. | The warmth and energy required for the conception of the artist and poet; elevation of feelings above vulgar life; refinement and splendour as to externals; and hence much of the improvements of society. |
| Wonder. | Immediately above ideality. | Some of those emotions concerned in surprise and the disposition to take delight in wonderful stories, events, &c. | Probably, in part at least, the love of singularity, being uncommon, romantic, and the disposition for novelty; admiration in part. |

| Physiognomical Expression, or Natural Language. | Uncontrolled, Excessive, or Diseased Manifestations. | Indications and Consequences of Deficiency or Low Activity. | Incidental Remarks. |
|---|---|---|---|
| Archness of expression, indicated by obliqueness and leering of eyes; moderate dilation of nostrils; irregular contraction and relaxation of lips. | Mysteriousness; dissimulation; prevarication; cunning; slyness; duplicity; manœuvering; deceit. | Too great openness; inexpedient frankness; bluntness of manner; off-handedness. | The behaviour, if not the character of individuals, is more influenced by the degree in which this power is possessed, and the direction it takes, than by any other single faculty. They who are defective in it are easily understood; in those who possess it largely we find continued puzzles. |
| Head elevated and rather retracted; erect attitude; steadiness and a degree of sternness of air; an expression approaching to harshness, if not disdain; eyes a little compressed; lips somewhat compressed, and a little arched upwards. | Excessive self-complacency; arrogancy and pride; fantastic assumptions; magisterial airs; groundless conceit of superiority; inflated imagination as to one's birth or station; the notion of supernatural elevation. | Want of confidence; depreciation of one's own abilities or condition; improper humility. | Some of the lower animals manifest this feeling in a remarkable degree. The proportion which it bears to the rest of the powers constitutes much of the diversity discernible in national character. |
| Declination of head, and gentle motion to either side; eyes softly opened; gentle smile; easy expansion of hands; voice subdued and insinuating. | Restless apprehensions and anxiety as to the opinion of others; too great accommodatingness; vanity and conceit; excessive bashfulness. | Indifference; want of courtesy; uncompliantness; impracticableness. | Generally more considerable in women than in men. Very discernible in some of the domestic animals. |
| An inquisitive eye; head frequently but only in a small degree turned aside; the expression as if one listened; slowness and softness of gait; the hands either drawn towards the body, but open, or projected somewhat forwards, and as if groping one's way. | Irresolution; painful disquietude; incapacitating doubts; wavering; timidity; fearful forebodings; despondency; consternation and panic. | Inconsiderateness; rashness; hairbrainedness. | Often very conspicuous in children; more observable in women than men, and in the females than the males of certain animals. |
| Tranquil pleasing expression of eyes and mouth; head a little in advance, and somewhat depressed; voice soothing and gentle. | Too great facility; imprudent liberality; liability to be imposed on by apparent distress. | Want of feeling; unconcernedness; hard-heartedness. | Possessed by several of the lower animals in various degrees. It is quite consistent with destructiveness. |
| The face either moderately elevated and advanced, or drooping forwards; in the former case, the eyes considerably opened, and directed upwards and inwards; in the latter, softly compressed; the hands expanded, and turned a little upwards, as if to receive; subdued voice. | Undue humility; prostration of intellect; superstition. | Want of reverence; levity as to religion; want of respect for superiors; boorish familiarity. | Peculiar to man. |
| Vivacity and sprightliness of air; eye rather enlarged; lips compressed into faint smile. | Too great facility of belief; credulity; rashness of anticipation as to good; over-sanguine expectations. | Distrust; despondency; disposition to forebode evil. | The sentiment is distinct from desire, which is an attribute of several faculties. |
| Energy and quickness of look; the eyes glancing, and subject to rolling motion; head somewhat unsteady. | Exaggeration, to a ludicrous or criminal degree; enthusiasm beyond reason and propriety; uncontrollable raptures; longing for the exquisite, the unattainably perfect, and the admirable, whether in nature or fiction. | Plainness and simplicity of taste; literalness; inability to get beyond matter of fact; coldness of conception; the want of poetic feeling. | Peculiar to man, and naturally points him out as a denizen of a higher and better state of being. |
| Head a little retracted; open eyes and mouth; hands expanded upwards. | Love of or feeling for the supernatural in an uncontrollable and painful degree; tendency to spectral illusions; subjugation to improbable fictions; imaginary inspirations, out-of-the world things. | Quiescent soberness of mind as to extraordinary and newly occurring matters; aversion to what is marvellous. | Not ascertained when most of the other functions were established, and hence left unnumbered on the plates and casts. Recent observations have strengthened the notion of its being distinct. |

| Names of the Faculties. | Situations and External Indications of the Organs. | Direct Material Functions and Uses. | Subsidiary Effects and Influence. |
|---|---|---|---|
| 17. Conscientiousness. | On the posterior and lateral parts of the upper surface of the brain, backwards from hope and upwards from cautiousness. | The sentiments of right and wrong, duty, obligation; the moral sense. | The basis of human laws; the dictates of justice and equity; approval and condemnation,—all distinct from, though readily combinable with the inferences and decisions of the intellectual powers. |
| 18. Firmness. | At the posterior part of the top of the head, in front of self-esteem. | Determinateness, perseverance, and passive fortitude of character. | To impart steadiness and constancy to the desires and decisions of the other faculties. |
| 19. Individuality. | The middle of the lower part of the forehead. | Conceived to be the faculty of observation, taken in a philosophical sense, and exercised in becoming acquainted, by whatever means, with facts, events, and circumstances, simply as such, and without regard to their uses or causes. | The power of attending to and becoming acquainted with details; of recollecting instances, examples, peculiarities; and consequently highly useful to the man of business and those professions which require ready application of acquired knowledge. Contributes essentially to education. |
| 20. Form. | At the internal angles of the eyes, so as to give width between them. | The power of judging of the quality of form in bodies. | An essential constituent in a talent for the imitative arts; useful in the pursuits of the mineralogist, the mechanician, and architect; also in the discrimination of persons. |
| 21. Size. | Supposed to be a little upwards from the preceding. | The power of judging of the dimensions of bodies. | The talent for perspective probably in part depends on it. |
| 22. Weight or Resistance. | Between the preceding and the following, so as, when large, to give a degree of heaviness to the eye-brow. | The power of judging of the momentum or weight and the consistency of bodies, and probably of adjusting the movements of the body to the laws of equilibrium. | Importantly requisite in mechanical science, and possibly in a great variety of corporeal exertions. |
| 23. Colouring. | About the middle of the arch of the eye-brows, so as to give a full and projected appearance to that part of them. | The faculty of distinguishing the shades and harmony of colours. | A constituent requisite in the arts of the painter, &c.; a source of pleasure in the contemplation of nature. |
| 24. Locality or Space. | Extends from above the inner angles of the eyes to the lower edges of No. 20. | The faculty of attending to and recollecting the positions of places and objects, and probably the desire of travelling, exclusive of a sense of its advantages. | Seems to impart a disposition and talent for various studies, as of geography, astronomy,—also landscape drawing. |
| 25. Order. | Adjoining No. 23. towards the outer angles of the eyes. | The faculty of arranging and methodizing objects as they are physically related. | Probably contributes to neatness, cleanliness, and correctness of appearance and domestic habit. |

| Physiognomical Expression, or Natural Language. | Uncontrolled, Excessive, or Diseased Manifestations. | Indications and Consequences of Deficiency or Low Activity. | Incidental Remarks. |
|---|---|---|---|
| Sedateness of aspect, approaching to solemnity, with peculiar quietness of manner, impressive tone of voice; open hands disposed to rise and fall slowly. | Extreme scrupulosity, censoriousness, fastidiousness, and severity in judgment; a sense of remorse amounting to self-hatred; agonizing apprehensions of the justice of the Divine Being. | Small power to resist the solicitations of the other faculties; torpidity as to just claims; dishonourable opinions as to the principles and conduct of other men; suspicion. | The disputes about the existence of this faculty imply the possession of it in a limited degree.—They who have it largely can no more doubt its reality than that of any other primitive power. |
| A fixed energetic look, approaching to sternness; a deliberate steady manner; the voice emphatic and somewhat hard, but not usually above the natural pitch. | Stubbornness; obstinacy; infatuate resolution. | Fickleness; unsteadiness; too great a tendency to yield. | What is usually called *will* is distinct from this sentiment, and is common to several faculties. |
| An air of inquisitiveness and prying, the very reverse of abstractness or reverie; a manner somewhat bustling and active; a marked but easily diverted attention to particulars. | Excessive minuteness and speciality of intellect; superficial disjointed knowledge; tedious prosing over individual heterogeneous things; interminable particularity. | Dulness or slowness of mind as to passing events; abstractedness; inability to remember and apply what is known; want of readiness in practical pursuits. | There is strong reason for imagining that there are two organs comprehended under 20,—one, the lower, the functions of which is to know and remember facts and circumstances; the other, or upper, is found large in those who are fond of natural history and similar pursuits. |
| Specific application to or regard for the objects of the power, as noticed particularly in the Chinese and French. | Inordinate fondness for imitating figures, whether by drawing, cutting on paper, or otherwise; and one of the elements in the disposition for caricaturing. | Imperfect discernment and faulty recollection of the diversities in form; consequent defect as an artist. | The senses of sight and touch, instrumental in the exercise of this faculty, may be quite perfect, and yet the faculty itself possessed in a very low degree. |
| Special attention to perspective, and the relations of magnitude and space. | Scarcely known to be excessive; but, possibly, certain hallucinations, especially experienced in imperfect light, may depend on an unusual endowment and diseased state of it. | Imperfect judgment of the size of bodies, and consequent unfitness for certain practical pursuits. | There is no necessary nor generally obvious connection between this and the preceding faculty. |
| Various movements of the body seem produced by and indicative or expressive of this power, especially such as conduce to the equilibrium or due balancing of the body. | Probably may prompt to some of the hazardous operations of the rope-dancer, &c. and to many Quixotic experiments and speculations. | Unfitness and want of inclination for mechanical science; possibly too, inexpertness in several sports and pastimes. | Farther observation is probably required to determine both the position of the organ and the extent of the range of the function. |
| Distinct characteristic fondness for the special objects of the faculty. | Glaring exuberance of colouring, or faulty preference of it in the fine arts. | Little regard for this department of the art; inability to distinguish tints and degrees of colour. | Seems to be quite unconnected with any peculiarity of the eyes. |
| The instinctive migrating propensity of certain animals, seemingly quite independent of reason; and there is ground to think that some men approach to them in manifestation of this power. | Ungovernable love of change as to places. | Difficulty or inability to recognise positions, and the absence or low degree of a wish to travel. | Some of the lower animals have this very considerably developed. In certain species the corresponding function is periodically excited. |
| The physiognomical indications of this faculty are frequently observable where intellect is exceedingly limited. | Troublesome exactness; a love of order and neatness amounting to a kind of passion; painful solicitude and restlessness on observing disorder. | Untidiness; irregularity; slovenliness; contentment in the midst of confusion; inability to rectify it. | The talent for philosophical arrangement and scientific systematizing may be aided by this, but depends on other powers. |

| Names of the Faculties. | Situations and External Indications of the Organs. | Direct Material Functions and Uses. | Subsidiary Effects and Influence. |
|---|---|---|---|
| 26. Time. | Supposed to be upwards from No. 24. and upwards and outwards from No. 25. | The power of conceiving and recollecting the relations of succession, time, and interval. | Probably the talent for chronological disquisitions, and the aptitude to preserve regularity and equality in musical notation. |
| 27. Number. | Towards the outer angles of the eyes. | The faculty of appreciating and recollecting the plurality of things, or the relations of numbers. | The talent for calculating, or performing operations on numbers. |
| 28. Tune. | Towards the lateral part of the forehead, upwards from No. 24. 26. and 28. | The power of perceiving and recollecting melody. | The enjoyment, and, where the natural instrument is subservient, the production of tune or song. |
| 29. Language. | About the middle of the orbitary plate, so as, when large, to give fulness and prominence to the eyes. | The faculty of using and recollecting signs expressive of our thoughts, independent of the knowledge of their meaning. | Language, in its common acceptation; the production of style; verbal memory. |
| 30. Comparison. | The central part of the forehead, between No. 19. and 13. | The power of perceiving resemblances, without determining their kinds. | Illustration by similies; explanation by comparing; reasoning by analogy; acuteness of discrimination, so far as likeness is concerned. |
| 31. Causality. | At the upper part of the forehead, on each side of the preceding. | The power by which we obtain a knowledge of and trace the relation between causes and effects; the "reasoning power" of Locke. | Genius for and acuteness in metaphysical disquisition; consecutiveness in reasoning; penetration as to the motives and principles of action. |
| 32. Wit. | The upper lateral parts of the side of the forehead on the side of the preceding. | More extensive than the word wit generally implies. Probably, in a large sense, the power of imagining, perceiving, and pointing out differences amid resemblances. | The sense and enjoyment of the ludicrous; one of the constituents in humour. |
| 33. Imitation. | The superior anterior portion of the forehead on the side of No. 13. | Perhaps, generally, the power of observing and copying those peculiarities which constitute the obvious characteristics of persons and things. | Aptness and expressiveness of manner in relating what has been observed; the tendency to copy nature, to resemble others. |

| Physiognomical Expression, or Natural Language. | Uncontrolled, Excessive, or Diseased Manifestations. | Indications and Consequences of Deficiency or Low Activity. | Incidental Remarks. |
|---|---|---|---|
| The general indications are obscure, but the various modes of marking time in music are special expressions, and they are sometimes practised where there is little tune, as, also, even by persons who are deaf. | Punctiliousness and morbid impatience as to the season or opportunity of doing things an apprehensiveness as to delay, amounting to feverish irritability; hurried stamping and gesticulation, in the performance of music. | An inability to recollect dates; inexactness as to time; procrastination from want of a feeling of excitement, independent of reason. | The organ is held to be only probable: but the peculiarity of the faculty seems unquestionable. |
| Certain operations performed by or on the fingers may be considered natural signs of the activity of the power; and a peculiar motion of the eyes has been observed in some individuals noted for a large portion of it. | An extraordinary fondness for arithmetical operations; a habit of enumerating, when no purpose is to be served. | Inaptitude for calculations; difficulty of discriminating the differences of numbers. | Some well-known instances of uncommon manifestations of this faculty seem quite miraculous to those who possess it only in a very moderate degree. |
| One of the most commonly noticed manifestations is a sort of upward and lateral motion of the head, as if in order more effectually to catch sounds. Birds frequently exhibit it in the very act of singing. The exercise of the vocal organs, as distinct from efforts at speech, is an unequivocal indication of the power. | Extreme fondness for and almost perpetual efforts at the production of pleasing sounds; horror of discord; music mad. | Indifference to or very limited liking for music, positive disinclination to it, or the feeling of its being an annoyance. | The external indication varies a good deal in form and size, and requires no small skill for its ascertainment. Some of the lower animals are well known to possess it largely. |
| The attention early paid by children to what is said, and their own efforts to speak, even when the real meaning of words is unknown to them, manifest the faculty. | Talkativeness to no purpose; profusion of words without proportional ideas; senseless palavering. | Paucity of words; poverty of style; hesitancy in speech; some kinds of stammering. | It is likely this faculty is confined entirely to arbitrary signs. The understanding of their meaning, and the intuitive perception of that of natural language, depend on other powers. |
| The natural language is not easily decided on, and will require for its discovery much more attention than has yet been bestowed on it. | Profusion of figures; tautology, or monotony of thought; parabolic quaintness of style; overloaded imagery. | Unpopular dryness of manner as to composition; scantiness of ideas in point. | Other faculties compare their own objects; but this comprehends the objects of various powers, so far as they are capable of exciting the idea of resemblance. |
| 31. Generally an air of intenseness and abstraction, as marked in the fixed eyes and knitted eye-brows. | Unpopular abstruseness and profundity of thought; perplexing inquisitiveness; unsatisfying ratiocination. | Superficialness of mind; incapacity for and dislike to deep thinking; want of consecutiveness of ideas; rambling manner; systematic preference of practical precepts to theoretical principles. | The proportions in which this and the preceding faculties are possessed, constitute the most remarkable intellectual difference among mankind. |
| The expression of wit, in the ordinarily used sense of the word, is well known by the laughing eye, a sort of half smile, and side-ward look. The indications of the general faculty are not perfectly ascertained. | Levity of spirit; a strong irresistible propensity to quibble and pun; extreme insobriety of intellect; a rage for unexpectedness of ideas. | Seriousness of spirit; distaste for the ludicrous. | The range of this faculty is far from being thoroughly ascertained. Its manifestations are often confounded with those of Nos. 30. 31. and the following. |
| The activity and facility of children in imitating what they see and hear, without knowing the meaning, are unequivocal evidences and expressions of the exercise of this power, which, also, is often abundantly manifested both by grown-up persons and various animals. | Mimickry; aping; off-taking. | Want of flexibility or versatility; inability to get out of self-constituted habits. | The direction of the faculty is determined by the combination of the powers, or the predominance of one or more of them. |

PHYSIOLOGY, a Greek term, which, in its modern acceptation, usually denotes that department of science which treats of the functions of the living animal body, and of the powers upon which these functions are dependent. See ANATOMY.

PIANO-FORTE, or GRAND FORTE PIANO, is a musical instrument of percussion, resembling the harpsichord in form, but, on account of its peculiar action, enabling the performer, as its name implies, to play soft or loud, has quite superseded that instrument. The piano-forte is so common, and so universally known, that any detailed account of it here seems to be in a great measure unnecessary. It may be considered as an improved species of harpsichord, the only difference between them being this, that the keys of the harpsichord are struck by quills and those of the piano-forte by mallets covered with leather. The wires of this instrument run along the belly or sound-board longitudinally, and are stretched upon short pins firmly fixed in low curved battens of wood, for keeping the wires about two-thirds of an inch distant, and perfectly parallel. The wires which lie to the right, and which give the upper notes, are the shortest and thinnest, those to the left, which give the lowest notes, are the largest, and those between them increase in length as they approach towards the left side, forming, by means of the battens, which are called bridges, a triangular figure. The wires of the higher notes are of steel or rather iron, and, beginning at No. 8 or 9, they gradually become thicker till they reach to about four octaves, when wires of copper are substituted to produce a deeper sound. Of late years, the size and power of this instrument have been greatly augmented; and to remedy any inconveniencies arising from these circumstances, grand piano-fortes have been constructed in a vertical form, in figure resembling a book-case.

The wires of this instrument are made to sound by means of hammers that are impelled upwards by keys, which are struck downwards or beat upon by the fingers. Numerous devices have been adopted for what is technically called damping; and if certainty of action and simplicity of construction entitle to a preference, the common balance-damper may undoubtedly claim the pre-eminence. This is merely a small round stem crossed by a flat bar at right angles, which has a slit in one end, so that as it rises it may be directed by a very slender pin in consequence of the upward pressure of the key, and at the other end is a small piece of cloth proportioned to the powers of the wire, which by falling on the wire stops the sound as soon as the key is released. The operation of the dampers must always be proportioned to the rapidity of the hammers, otherwise the tones of the instrument will be confused. Grand piano-fortes most commonly have two pedals, the one raising all the dampers, the other throwing the whole of the key-frame more or less to the right, by which means the hammers are at same time slid in a body to the right, about a quarter of an inch, so as at pleasure to quit either one or two of the left-hand wires of each note, and to strike only one or two, for diminishing the sound as may be desired in a greater or less degree. Sometimes other pedals are affixed for opening a cover to allow an increase or diminution of the sound.

The square piano-forte differs from the grand in point of form, although in its action and movements it is nearly similar. Each note has two wires; down to G on the clef-line they are steel, the middle ones are brass, and about half an octave of the bass part are of copper, but the eight or ten lowest notes are of brass wires, which produce a deeper tone in consequence of a thinner wire twisted round them in an open spiral manner; and of late the bass notes have, on the principle of increased length producing an increase of tone, been formed of spiral wires entirely, but the quality of tone is much inferior. These pianos likewise have pedals, but are not used for sliding the keys and removing the hammers in a lateral direction, and one pedal for raising the dampers while tuning is all that is requisite.

There is likewise a species of this instrument called a Celestina, the notes of which are formed by collision, and whose fascinating and delicate tones are produced by the passage of silk lines over its wires.

The piano-forte has been called a national instrument, the invention of it being ascribed to the celebrated English poet Mason. It is likewise said to have been invented by Christopher Gottlieb Schroëter, a native of Hohenstein in Bohemia. The Germans had attempted to make keyed dulcimers, which in some degree were susceptible of the *forte* and *piano*; but these instruments were extremely deficient both in delicacy and justness, and the performer never could be certain of producing the precise strength of sound that was required. Mr Mason, however, obviated this and other imperfections, by detaching the mallet entirely from the key, so that they could only have a momentary connection,—and by this single improvement is the British piano-forte distinguished as being superior to every other.

PICARDY, an old province of France, which now forms the department of Somme; it is bounded on the north by Hainault, Artois, and the strait of Dover, on the south by the isle of France, on the east by Champagne, and on the west by Normandy and the English channel. Its figure is usually compared to a bent arm, and it is level, and productive of fruits, wine, corn, and hay. Wood being scarce, turf is in general use for fuel. Picardy is the seat of a flourishing trade, and is watered by the rivers Somme, Oise, Canche, Lanthie, Lys, Aa, Scarpe, and Deule. The trade in corn, fish, and pit coal is considerable. Amiens is the capital. See AMIENS.

PICTS, an ancient people concerning the origin of whom authors are much divided; though Bede and other historians use the term as synonymous with Caledonians. In support of the opinion, that the Picts were the descendants of the old Caledonians, several reasons are urged by Dr Macpherson of Slate, an antiquary of considerable learning and research, and the words of Eumenes, *Caledonum, aliorumque Pictorum, ſilvas, &c.*, seem to indicate, that the Picts and Caledonians were one and the same people. The history of the Picts is involved in great obscurity. It is more than probable that they were not known by that name before the second or third century. The first author who makes mention of any Pictish king, is Adamnan, abbot of Iona, and the oldest after him is Bede. War was carried on for ages, with various success, between the Picts and Scots. But the former were at length subdued by the latter in the reign of Kenneth II. and their name was afterwards lost in that of the conquerors with whom they were incorporated. They continued, however, for some ages after to command a great deal of respect. The chief seat of the Pictish kings was at Abernethy; but, according to Adamnan, Brudeus, the cotemporary of Columba, and the first of these kings mentioned by any writer of authority, had a palace at Inverness, which was perhaps near the extremity of his territory in that quarter. The language of the Picts was very probably the Gaelic or Celtic, because, through the east and north-east coast of Scotland, which were possessed by that people, the names of many places, rivers, and mountains are evidently Gaelic. There appears no reason to suppose that the manners and customs of the Picts were any other than those of the old Caledonians and Scots, concerning which the Greek and Roman writers relate many particulars. See Mr Chalmers' *Caledonia*.

PIEDMONT, in Latin PEDEMONTIUM, so called from its situation at the foot of the Alps which separate France from Italy, is a principality of Italy belonging to the king of Sardinia. It extends 150 miles in length and 90 in breadth, and is bounded on the north by Valais, on the east by Milanese, on the south by the county of Nice and the duchy of Genoa, and on the west by France and Savoy. It includes the duchy of Montferrat, and is in some parts mountainous, but everywhere very fertile. Among the mountains are rich and fruitful vallies, which are as populous as any part of Italy. The forests afford a great deal of game, and there are rich mines of several kinds in the mountains. The hills abound with vines which afford plenty of excellent wine. The white wine of Piedmont is remarkably lucious; the tartish red wine, called vino brusco, is said to be very wholesome for fat people, and the sweet wine is recommended as a stomachic. The silk of this country is esteemed the best in Italy; and the trade in black cattle is said to produce no less than three millions of livres per annum. The silk worm thrives so well, that many peasants make more than 100lb. of silk yearly. Hemp and silk are the chief articles of commerce, besides which the Piedmontese trade in corn, rice, wines, fruits, flax, and cattle. The principal rivers are the Po, which flows out of mount Visco, the Sesia, the Doria, the Stura, and the Tanaro. Piedmont was formerly divided into eleven small provinces—Piedmont proper, the vallies between France and Italy, the valley of Saluzzo, the county of Nice, the marquisate of Susa, the duchy of Aost, the Canavese, the lordship of Vercelli, the county of Asti, and the Langes; and as it lies at the foot of the Alps which separate France from Italy, it was considered as a part of Lombardy. Before the revolution there were, in this principality, about 50 earldoms, 15 marquisates, and a number of lordships and abbeys. The Piedmontese are, by some authors, represen ted as lively, artful, and witty, the natives of the mountains of Aosta excepted, who are farther distinguished by large wens. The language generally spoken is a mixture of French and Italian. Turin, the principal city, is the residence of the king of Sardinia. See TURIN.

The Piedmontese republic was erected by the French, after the model of their own government then prevailing, on the 10th December 1798, out of the king of Sardinia's ci-devant Italian dominions. This republic, which consisted of four departments, called Eridan, Sesia, Stura, and Bormida, was overthrown by the Austrians in the summer of 1799, when the old government was restored. In the following year the whole of these territories again submitted to the French, and in 1802 they were irrevocably annexed to the French republic, and divided into six departments, named the Po, Marengo, Doria, Sesia, Stura, and Tanaro.

PIETRA-MALA, a town of Tuscany, remarkable for having a mountain in its vicinity from which streams of bright flame are discharged to the height of several feet. It is 24 miles north by west of Florence.

PILE-ENGINE. See MECHANICS.

PILGRIMAGE, a journey to places deemed peculiarly holy, undertaken for the purposes of devotion, and regarded as so acceptable to God as to be sufficient not only to obtain the remission of the greatest sins, but also to procure a high degree of merit. Pilgrimages have been common in all ages and in all countries; and at this day prevail in India, China, Tibet, and in almost all the countries of Asia. In the middle ages, when superstition was cherished by ignorance, this folly became extremely common in the Christian church, and multitudes from all parts of Europe visited Jerusalem to worship at the scenes of our Lord's sufferings and death, as well as Rome, Tours, and many other places consecrated by particular saints. Loretto is still a place of resort to those who believe that they will see there the very habitation of the Virgin Mary. When popery prevailed in Britain, the shrine of Thomas à Becket, and that of St Andrew in Scotland, were much frequented by the pious. Lough-Fin, or White Lake, in Ireland, is yet resorted to by crowds of popish penitents during the summer months of every year. Pilgrims obtained the name of palmers from the circumstance of their carrying palm when they returned from visiting Palestine. In a figurative sense, the course of human life is in the Scriptures beautifully represented as a pilgrimage. Gen. 47. 9. Heb. 11. 13.

PILLAU, a sea-port of Prussia, on the Baltic, situated 30 miles west by south from Konigsberg, of which it is the port. The streets are broad, and the houses are constructed in the Dutch taste. The harbour is good and well fortified, and several hundred vessels arrive annually. Here is a good sturgeon fishery, and also a magazine for military stores. The inhabitants amount to about 3000.

PILOT, in the extended sense of the term, is the steersman of a vessel, but in a restricted sense is the name given to that order of mariners who superintend the navigation along coasts, through straits, over bars, and in rivers, into and from ports, roads, bays, and havens. Those who belong to this profession are stationed in coast and sea-port towns, and take charge of vessels within their respective districts, according to particular regulations. Those who conduct ships up the Thames from different parts of the coast, are examined and approved by the wardens of the society of Trinity-house, and are liable to fines and other punishments for misconduct. The lord-warden of the *Cinque* ports has the power of making rules for the government of this class of men, and they are subject to pay ancient dues, out of their wages, for the use of the pier of the Trinity-house of Deptford. In France and other maritime countries, the laws affecting pilots are very specific, and often severe.

By the regulations regarding pilots in the Royal Navy, the commanders of the king's ships are directed to encourage this useful body of men, and to treat them with equal respect as warrant officers. Pursers are to accommodate them with hammocks apart from the common sailors; and the pilot is to have the full command of the ship's navigation, and the captain to see that he is obeyed by the men. At the same time he is to watch over the conduct of the pilot, and prevent him from bringing the ship into danger. In foreign ports, captains are to pay pilots according to the custom of the country. The East India Company have an establishment of pilots at Bengal to manage the river navigation. They are English sailors inured to the business from boyhood, which is reduced to a regular system, and conducted with much ability. By the Danish laws, an ignorant pilot is compelled to pass three times under the keel of the ship.

PIN, a small instrument made of brass wire, and chiefly for fastening female dress. The wire, in the manufacture of pins, is reduced to the proper degree of thickness by causing it to pass between two wheels through a circle of iron of the size wanted, it is then straightened and cut into pieces of from three to four yards in length, and then into such as will make six pins. Each end of each of these pieces is next sharpened by boys on grinding-stones or steel-mills, then a pin's length is cut off each end, and the operation renewed till the whole length is pointed. The head is formed by winding one piece of wire upon another, with great rapidity, by means of a spinning-wheel; then the interior piece is drawn out, and the circles, formed in the other by revolutions of the wheel, are cut assunder, and to soften them they are thrown into iron pans and heated on a furnace; they are afterwards smoothed by children, on anvils, with hammers wrought by a lathe; the head is then fastened on the blunt end of the ground piece of wire, with great dexterity, by a quick motion of the hand and a turn or two of the lathe. The pins, brought thus to perfection as to their form, receive their white colour by being thrown into a copper containing a solution of tin and lees of wine, and they are polished by being afterwards stirred in a tub among bran. This is driven off by wind as corn is winnowed; and the pins are now finished and ready for the market. The different operations of pin-making form distinct occupations, and are produced by Dr Adam Smith to illustrate the advantages resulting to commerce from a division of labour.

PINDAR, a distinguished lyric poet, was a native of Thebes, and the son of a flute-player, under whom he studied music, as he did poetry under Myrtis, according to Suidas. The first effusions of his muse are said to have been wild and luxuriant. Corrina, also a lyric poetess, to whom he communicated one of these juvenile essays, in which he had crowded almost every subject for song furnished by history and mythology, told him, smiling, that "he ought to sow with the hand and not empty his sack at once." In the public trials of skill which then prevailed in Greece, he obtained the victory over Myrtis, his instructress, but was vanquished by Corrina, his fellow-student, five times, though it is thought that the lady's beauty had more influence over the judges than her poetical merit. His poetry was traduced in his native city, and ridiculed by the comic poets. Whether these censures were well or ill founded, they were of advantage to our poet, as they led him to adopt a more correct and chastened style than that in which he had hitherto indulged; and his fame became so great and extensive, that every hero, prince, and potentate was desirous of being celebrated by him. It appears from his odes that he was frequently present at the different games which were from time to time celebrated in Greece, and composed an ode in honour of those of Olympia, which was sung by a chorus accompanied by instruments. His moral character was good, and as his genius was transcendant, he obtained many honours; and, by an express oracle, the inhabitants of Delphos were commanded to set apart for his use the half of the offerings of first fruits brought to the shrine of Apollo. He was born about 520 years before Christ, and lived, according to some authors, to the age of 90.

PINE-APPLE. See GARDENING.

PIONEER, one whose business is to level the road, throw up works, or sink mines, in military operations. Our regiments of infantry and cavalry have three or four pioneers, each provided with aprons, hatchets, saws, spades, and pick-axes.

PIRACY, the practice of robbing upon the sea. This offence, by the common law, consists in committing those acts of robbery and depredation upon the high seas which, had they been committed upon land, would have amounted to felony. By the statute 25 Edward III. this crime is held to be felony; but since that time the law respecting its punishment has been frequently revised and modified. To encourage the defence of merchant ships against pirates, the commanders or seamen wounded, and the widows of such seamen as are slain in any piratical engagement, are entitled to a bounty to be divided among them, not exceeding one-fiftieth part of the value of the cargo on board, and such wounded seamen shall be entitled to the pension of Greenwich hospital, as if they had served in a ship of war. Persons convicted of having molested their fellow subjects at sea during the time of war, or of having assisted the enemy, are liable to the pains and penalties awarded by the law to pirates.

PISA, a large city of Tuscany, on the river Arno, capital of Pisano, and an archbishop's see, with a university, and three forts. The Arno is crossed by several bridges of marble, and a canal extends from the city to Leghorn. The manufactures consist of steel, jewellery, embroidery, damasks, velvet, and taffetta, with cotton stuffs. The population has decreased, however, from upwards of 100,000 to little more than 20,000. The cathedral is a magnificent structure, and on the right side of the choir is a leaning tower much noticed by strangers; and, besides this, the city contains upwards of eighty other churches, of which that of St Stephen, belonging to an order of knights, is worthy of notice. The palaces of the grand duke and archbishop, the arsenal, the great hospital, and the exchange, a superfluous pile, now that the trade of Pisa is removed to Leghorn, are among the most conspicuous of the public buildings. The city is supplied with water from hills five miles distant, by means of an aqueduct consisting of 5000 arches. The adjacent country is fertile in corn, wine, and fruits. Long. 10° 17′ E., Lat. 43° 43′ N.

PISISTRATUS, an Athenian distinguished for gallantry and eloquence, by means of which, aided by his liberality, he became so popular that he resolved to make himself master of his country. This ambitious design was opposed by Solon, the venerable legislator of Athens, but it succeeded by artifice. Pisistratus cut his body in several places, and pretending he had been wounded by enemies, the unsuspecting people allowed him a guard of fifty men. The first use he made of this armed band was to seize the capital and render himself absolute. After this he was several times driven into exile; but at last established himself as the sovereign of the city; and, though he avenged himself of his enemies, he never lost sight of the public good. He is celebrated for justice, liberality, and moderation. He encouraged learning, established a public library, and to him the world is indebted for the preservation of the poems of Homer. He died about 327 years before the Christian era, after he had enjoyed the sovereignty of Athens 33 years, including the period of his banishment, and was succeeded by his son Hipparchus.

PITCAIRN ISLAND, an island in the south Pacific ocean, in west long. 133° 20′ 45″, and south lat. 25° 22′. It is remarkable as the site of a colony founded by ten mutineers from the Bounty, Captain Bligh, which was dispatched by the British government, in 1787, to collect plants to be transplanted to the colonies in the West Indies. Pitcairn Island is without a river or harbour, but is fertile and capable of cultivation. It was seen by Captain Cook in 1773, and was touched at by an American vessel in 1808. The mutineers, with six men from Otaheite, and eleven women, remained here unknown till the year 1814, when the Briton frigate fell in with the island. Of the original stock, only one of the mutineers, John Adams, and the old women, were found alive, but there were forty-eight inhabitants occupying a neat village under the superintendance of Adams. For an interesting account of Pitcairn Island, see *Quarterly Review*, Vol. XIII., and the *Edinburgh Philosophical Journal*, Vol. III.

PITCAIRNE, Dr Archibald, an eminent physician, and an ingenious poet, was born in Edinburgh in 1652. He was descended from an ancient family of Fifeshire, and was educated at a private school in Dalkeith, and the university of Edinburgh. His friends wished him to study theology, but his own inclination led him to cultivate the study of law, which he pursued with an ardour which was injurious to his health. To recruit his strength, he undertook a journey to the south of France; but when he reached Paris he found himself so much recovered as to be able to renew his studies in that city. Here his attention was directed to physic; and, on his return home, he applied himself to the cultivation of mathematics, in which he made great progress, and improved on the method of infinite series then adopted from Dr Willis of Oxford. Having resolved on medicine as his profession, he made a second journey to Paris, that there he might obtain the requisite qualification. In 1680, the faculty of Rheims conferred on him the degree of doctor of medicine, as did the university of Aberdeen in 1689; and the surgeons of Edinburgh, among other medical honours which he received, admitted him, unsolicited, a member of their college. When, moreover, the Royal college of Physicians, was instituted in Edinburgh, his name appeared among those who graced the original patent. In 1688, he published a tract, the object of which was to ascertain Harvey's right to the discovery of the circulation of the blood. In 1692, he was elected to the medical chair in Leyden, which he filled for some time with great reputation; but having returned to Scotland to marry the daughter of Sir Archibald Stevenson, he was induced to remain in his native land. Here he soon established himself in extensive medical practice, and was appointed professor of medicine in the university of Edinburgh. He collected the finest private library, perhaps, at that time in Europe, which after his death was bought by the czar of Muscovy. He died in 1713, universally regretted.

PITCH, a resinous juice extracted from firs and pines, and employed in various arts. It is the residuum of the distillation of tar. See Tar and Turpentine.

PITCH, Mineral. See Petroleum.

PITCAITHLEY, a town in the parish of Dumbarney and county of Perth, celebrated for its mineral springs, on account of which it is much frequented.

PITOT, Henry, a French mathematician, of a noble family in Languedoc, born at Aramont in 1695. He was a member of the Royal academy of Sciences at Paris, in the Memoirs of which society he wrote a variety of papers. In 1731 he published his excellent work on the Theory of Manœuvring Ships, which was translated into English, and procured him the honour of being elected a member of the Royal society of London. The city of Montpelier was by him supplied with water by means of a noble aqueduct from a distance of three leagues. He was a practical philosopher, and a man of great probity and candour. He died in 1771.

PITS, John, an eminent biographer, was born at Alton in Hampshire in 1560, and died in 1616. He wrote in Latin the lives of the kings, bishops, and apostolical men and writers of England, and his work *De illustribus Angliæ Scriptoribus*, was published after his death.

PITT, Christopher, an English poet, who is best known for an excellent translation of the Æneid, besides which he translated Vida's Art of Poetry, and wrote some ingenious poems. He died in 1748.

PITT, William, Earl of Chatham, was the second son of Robert Pitt, Esq. of Roconnock, in Cornwall, where he was born in 1708. He was educated at Eton, from whence he removed to Trinity college, Oxford; but owing to a hereditary gout, which had attacked him at Eton in his sixteenth year, he left the university without taking any degree. His Lordship applied himself, notwithstanding this malady, to the acquisition of general knowledge, endeavouring anxiously to cultivate those powers of mind which were one day to render him the ornament of his age and nation. Through the interest of some of his friends he obtained a commission of coronet in the Blues. In 1735 he quitted the army on being chosen into parliament for the borough of Old Sarum, and he very soon distinguished himself by his intellectual faculties and powers of elocution. So successful was he in opposing Sir Robert Walpole, that the Dutchess of Marlborough, who entertained a deadly hatred to that minister, left him L.10,000 at her death, avowedly on the ground of his public services. On the change of administration he was appointed vice-treasurer of Ireland, and paymaster-general of the forces, which places he resigned in 1755; but a new ministry being formed in the year following he obtained the post of secretary of state in the room of Mr Fox, afterwards Lord Holland. Owing to his inflexible opposition to the Duke of Cumberland, as general of the German war, he was soon deprived of the seals. By the public opinion, however, his Majesty was obliged to recal him, and he accordingly resumed his place of secretary on the 29th of June 1757, when he formed a cabinet of his own choosing. The genius of this illustrious statesman now shone forth with unclouded splendour; yet to the astonishment of almost the whole kingdom, he resigned his office on the 5th of October 1761. This he did in consequence of his having, by the accuracy of his intelligence, discovered the existence of that family compact between the French and Spanish branches of the house of Bourbon, the secret influence of which had rendered abortive some recent attempts at making peace. In the privy council he declared his conviction that Spain was about to join France against us, and that it was necessary to prevent her by commencing hostilities first. The rest of the cabinet thought otherwise; and in debating the question, Pitt exclaimed, "I will not give them leave to think,—this is the time, let us crush the whole house of Bourbon. But if the members of this board are of a different opinion, this is the last time I shall ever mix in its councils." The applause of all good men accompanied Mr Pitt in his retreat, and his private fortune was increased by an annuity of L.3000 as a reward for his services, to be continued during his life and that of his lady. This gratuity was dignified with the title of Baroness of Chatham to his lady, and that of Baron to heirs-male. At that time Mr Pitt declined the title of nobility, but he afterwards accepted of a peerage under the title of Baron Pynsent and Earl of Chatham, and was at the same time appointed Lord Privy-Seal. In 1766 the necessities of the government once more called him to a share in it; the formation of a new cabinet was entrusted to him, but the undertaking did not prosper in his hands. His brother-in-law and old associate Lord Temple, and the Marquis of Rockingham, could not enter into his views or cooperate with him; and by his acceptance of a peerage he had offended many of his favourers. The last appearance Chatham made in the House of Lords was in April 1778. His strength and health were then almost exhausted; but the question was important, being a motion of the Duke of Richmond, for an address to the king, in which the necessity of admitting the independence of America was broadly insinuated. His Lordship, with his accustomed energy, deprecated such a consummation. "I rejoice," said he, "that the grave has not closed upon me, that I am still alive to lift up my voice against the dismemberment of this ancient and noble monarchy, pressed down as I am by the load of infirmity. I am little able to assist my country in this most perilous conjuncture; but, my Lords, while I have sense and memory, I never will consent to tarnish the lustre of this nation by any ignominious surrender of its rights and fairest possessions. Shall a people, so lately the terror of the world, now fall prostrate before the house of Bourbon? It is impossible. In God's name, if it is absolutely necessary to declare either for peace or war, and if peace cannot be preserved with honour, why is not war commenced without hesitation. I am not, I confess, well informed of the resources of this kingdom, but I trust it has sufficient to maintain its just rights though I know them not. Any state, my Lords, is better than despair. Let us at least make an effort, and if we must fall let us fall like men." On the Duke replying, Chatham attempted to rise a second time, but the long speech he had previously made had overcome his spirit. He was unable to speak, and fell down in a convulsive fit. Though he recovered for that time, his disorder continued to increase till the eleventh of the following month, when he died at his seat at Hayes. His body, after lying in state, was solemnly interred in Westminster abbey, where a monument was erected to his memory at the national expense.

"The manners of Lord Chatham," says the author of the history of his eventful life, "were easy, his conversation was spirited and gay, and he readily adapted himself to the complexion of those with whom he associated. By an irresistible energy of soul he was haughty and imperious. He was incapable of associating councils, and he was not formed for the sweetest bands of society. He was a pleasant companion, but an unpleasant friend. The ambition of our hero, however generous in its strain, was the source of repeated errors in his conduct. To the resignation of Lord Carteret, and again, from the commencement of the year 1770, his proceedings were bold and uniform. In the intermediate period they were marked with a versatility incident only in general to the most flexible minds. He dealt too freely with invective. He did not pretend to an ignorance of his talents, or to manage the display of his important services. Himself was too often the hero of his tale, and the success of the last war the burden of his song. Patriotism was also the source of some of his imperfections. He loved his country too well; or, if that may sound absurd, the benevolence at least that embraces the whole human species had not sufficient scope in his mind. He indulged too much a puerile antipathy to the house of Bourbon; and it was surely the want of expansive affections that led him to so unqualified a condemnation of American independency. But the eloquence of Lord Chatham was one of his most striking characteristics. Here he outstripped his competitors, and stood alone the rival of antiquity. His oratory was unlaboured and spontaneous; he rushed at once upon the subject, and usually illustrated it rather by glowing language and original conception than by cool reasoning. His person was tall and dignified; his piercing eye looked through the souls of his opponents; his countenance was stern, and the voice of thunder sat upon his lips: anon, however, he could descend to the easy and playful. His voice seemed scarcely more adapted to energy and to terror, than it did to the melodious, the insinuating, and the sportive. If, however, in the enthusiasm of admiration, we can find room for the frigidity of criticism, his action seemed the most open to objection. It was forcible, uniform, and ungraceful. In a word, the most celebrated orators of antiquity were in a great measure the children of labour and cultivation. Lord Chatham was always natural and himself."

**PITT**, The Right Hon. WILLIAM, an illustrious statesman, was the second son of the great Lord Chatham and Lady Harriet Grenville, sister to Earl Temple, and was born on the 28th day of May 1759. His father, with the view of making him a statesman, directed his attention to his early education, and taught him to argue with precision, and to declaim with force and elegance. At a proper period he was placed under the tuition of Dr Turner and Dr Prettyman of Pembroke-hall, the latter of whom was also his private tutor. Stimulated by a thirst for knowledge, he studied so intensely, that he was soon admitted to the degree of Master of Arts, and also acquired such reputation in the university for talent, industry, and propriety of deportment, as proved highly advantageous to him in his subsequent career. On leaving the university he was entered at Lincoln's Inn, where he was not long of obtaining a similar distinction to that of his Alma Mater, and of receiving some marks of favour. He was called to the bar in 1780, and the first cause in which he was retained was an East India dispute. By means of Sir James Lowther he obtained a seat in Parliament for the borough of Appleby, which he occupied for the first time in the month of January 1781. Adopting the opinion of his father, Mr Pitt did not decidedly join any party, and sat indiscriminately in the house. Appearing, however, on the side that opposed Lord North, he in an able manner supported Mr Burke's plan of economy, which being founded on a progressive retrenchment, appeared well calculated to diminish the influence of the crown. After a long debate the bill was rejected, but it was afterwards introduced and carried into effect to a certain extent. The American war Mr Pitt reprobated as one of the most ruinous conflicts of modern times; and he therefore strenuously supported the motion of Mr Fox, that ministers should immediately take every possible measure for concluding a peace with our American colonies. Next to the American war, one of the chief objects to which the nation then directed its attention, was a more equal representation of the people in Parliament. On the 7th of May Mr Pitt, in a speech replete with argument and truth, moved, "That a committee be appointed to inquire into the state of the representation of Parliament, and to report to the house their observations thereon," which motion was rejected by a small majority. Various reforms were effected during the short existence of the Rockingham administration, and many others would very probably have been accomplished, had not the death of the Marquis of Rockingham suddenly brought about remarkable changes. Owing to new arrangements Mr Fox retired, and Lord Shelburne obtained the office of first lord of the Treasury, and placed Mr Pitt in the situation of chancellor of the Exchequer,—a situation than which he would accept of none inferior, although he was little more than 23 years of age. Peace was concluded by this administration, which in a short time gave way to the coalition ministry formed between Lord North and Mr Fox, together with their representative friends. Mr Pitt was now the promoter of every measure for amending the representation of the people, reducing the taxes, and abolishing useless places; and so he continued till Mr Fox's East India bill, which was carried in the Commons, but rejected by a majority of 19 in the House of Lords, occasioned a breaking up of the administration.

In 1783 the important offices of first lord of the Treasury and chancellor of the Exchequer were conferred on Mr Pitt, who thus became prime minister before he was full 24 years of age. A new bill for the better government of India was shortly after brought forward by him, which however was, after a short debate, rejected by a majority of eight. On this a coalition or immediate dissolution of parliament became indispensible, and the latter was adopted on the 25th of March 1784. The premier having been returned for the university of Cambridge, again brought forward his bill, in an amended form, for the regulation of India, and carried it triumphantly in both houses. During Mr Pitt's administration, the regency and the French revolutionary war were the principal events which occupied the public attention. In the former he was against the Prince of Wales being regent with full powers, and in the latter decidedly of opinion that a war with France was inevitable. (See BRITAIN.)

Mr Pitt effected the union of Ireland to Great Britain in 1800, and he soon afterwards retired from office. The peace of Amiens, settled under the Addington administration, was of short continuance, and a new war ensued. In 1804 Mr Pitt resumed his post as first lord of the Treasury, at the head of an arrangement formed of part of the ministers then in place, with the addition of some of his own friends. But as many of his former colleagues had joined the standard of opposition, he was encompassed with many difficulties, and he may almost be said to have been left to wield the energies of the state alone. For his exertions he was by some venerated as the saviour of the British constitution, while by others he was viewed as its destroyer. One party fondly called him *the pilot that weathered the storm*, but another insisted that the *storm* was yet far from being weathered. Mr Pitt effected a coalition with Russia and Austria against France, which it was hoped these two powers would ultimately reduce to subjection. To such expectations, however, the battle of Austerlitz put an end. While waiting with anxiety the result of his plans, the news of the French victory found Mr Pitt at Bath, to which he had been under the necessity of retiring in the end of 1805. The proud feelings of this great man were now almost subdued. His indisposition originated in a gouty habit, which his anxious and over-laboured life, together with his convivial habits, had strengthened rather than abated. The Bath waters afforded him no permanent relief, and returning to his seat at Putney in a very debilitated state, he died there about four o'clock on the morning of the 23d of January 1806, in the 47th year of his age,—the same day on which he first took his seat in Parliament. A public funeral was ordered him by Parliament, and his remains were removed, for the contemplation of his friends, to the painted chamber in the house of Lords, where his body lay in state, on Thursday February 20, 1806. The sum of L.40,000 was granted by Parliament to discharge his debts. A mausoleum is erected to his memory in the Guildhall of London, and a monument in Westminster abbey, and his statue is placed in the university of Cambridge.

Ambition and the love of power were the ruling passions of Mr Pitt. It seems generally admitted, however, that, under a repulsive exterior, he bore an amiable mind. He passed his life in contests, and therefore it is perhaps difficult to speak of his character in such a manner as to escape contradiction; yet it may be safely asserted, that he was an able financier, a powerful speaker, and a man of liberal principles. "With a manner somewhat reserved and distant," says Mr Rose, "in what might be termed his public deportment, no man was ever better qualified to gain, or more successful in fixing the attachment of his friends, than Mr Pitt." See Gifford's *Life of Pitt*, Tomline's *Life*, &c.

**PITTSBURG**, a populous town of North America, and the capital of Alleghany county, situated on a point of land at the confluence of the rivers Alleghany and Monongahela. It contains a court-house, a jail, an academy, a library of about 2000 volumes, eight places of worship, five banks, and a national armoury. Pittsburg is the mart of commerce for Philadelphia with the western country, and also for the numerous establishments on the two rivers between which it is situated. Among the manufactures of this place, are those of steam-engines, five glass-houses, four air-furnaces, three breweries, sixty-seven flour-mills, &c. The manufactures in 1814, consisting of paper, cotton, glass, and iron, amounted to 200,000 dollars. Pittsburg is 300 miles west by north of Philadelphia. West long. 80° 81′, and north lat. 40° 32′.

**PIUS I.** POPE AND SAINT, succeeded Hyginus, A. D. 142. He was an Italian. He condemned the heresies of Valentinian, and suffered martyrdom in 157.

**PIUS II.** POPE, Æneas Sylvius Piccolomini,—was born at Corsignano in 1405, the descendant of a noble family. His talents and love of learning appeared at an early period; and after he had finished his course at the university of Sienna, his attainments recommended him to Cardinal Capronica, by whose patronage he was brought into notice, and was led to take an active part in the opposition to Eugenius at the council of Basil. After this he was sent to promote the cause of Felix, the rival of Eugenius, at the court of the Emperor Frederick III. who admitted him among the number of his personal friends, prevailed upon him to resign all his offices, that he might enter wholly into his service, and appointed him secretary of the empire. Placed thus in a situation favourable to his ambition, he aspired to the popedom, to which he was promoted on the death of Callixtus II. and assumed the name of Pius II. He was, throughout his pontificate, jealous of the papal prerogatives, and endeavoured, soon after his appointment, to unite the Christian princes against the Turks; and he increased his power by declaring the kingdom of Naples a fief of the church, and made the king engage to assist the pope against his enemies with the whole strength of his kingdom. While his ambition was ungratified, his whole efforts had been exerted to restrain the power of the pope within the limits allowed by the Canons; but after his elevation to the pontificate, none of his predecessors had ever laboured more assiduously to extend that power. He was a profound scholar, an elegant Latin writer, and left behind several compositions, chiefly historical, in that language. He died in 1464, in the fifty-ninth year of his age.

**PIUS IV.** POPE, John Angel,—was born at Milan in 1495, of humble parentage, but raised himself by his talents and the important services he performed to the papal see under Clement VII. and Paul III. by whom he was entrusted with several legations. He obtained a cardinal's hat from Julius III. and on the death of Paul IV. he was advanced to the pontificate. At this time, the progress of the Reformation had led several nations to throw off their allegiance to the pope; and Pius IV. anxious to preserve the power of the church, renewed the council of Trent, which had been suspended; he also adorned the city of Rome with new edifices; and, after a turbulent reign, he died in 1565.

**PIUS V.** POPE, Michael Ghislieri,—was born at Boschi, a small town in the north of Italy, in 1504, and spent the early part of his life as a Dominican friar. Paul IV. created him a cardinal, and he succeeded Pius IV. in the papal chair. He was a cruel persecutor of the Protestants, and discovered a flaming zeal to maintain the high claims of the pontificate. He made war on the Ottoman empire, excommunicated Queen Elizabeth of England, and caused the decrees of the council of Trent to be put in execution. But he was withal a lover of learned men, and of exemplary conduct. He met his death by the stroke of a stone in 1572.

**PIUS VI.** POPE, John Anthony Baschi,—was born at Cesena in 1717. He had good talents, received an excellent education, and rose rapidly to the highest dignities of the church. He was in some measure indebted to the interfering interests of rival candidates for his elevation to the popedom; and after his election he met with much opposition, but, by acts of benevolence and prudent conduct, this spirit, by degrees, subsided. He was fond of parade, and of exhibiting himself in public, and received the visits of sovereign princes with great magnificence. He formed the design, and partly executed it, of draining the Pontine marshes. After the death of Maria Theresa, he repaired to Renna to remonstrate with the Emperor Joseph II. against the policy which he had adopted towards the church; but he was obliged to return to Rome without accomplishing the object of his journey. His opposition to the proceedings of revolutionary France was still more unsuccessful. His bulls, his nuntios, his negociations, and his arms, were all now unable to preserve his power, or to guard his person; he became the prisoner of the French, and was, by them, carried from Rome to a convent near Florence; and is said to have exhibited, in this state of humiliation, an excellent example of Christian resignation. He was afterwards removed to the interior of France, where he died in 1799, and left behind him the reputation of a pontiff devoted to the duties of his station, free from hypocrisy and fanaticism, and of morals pure and exemplary.

PIUS VII. POPE, Chiaramonte,—was elected to the pontificate by a conclave held at Venice, by order of the Emperor of Germany, after the church had been for some time without a head. Soon after his elevation he repaired to Rome, where he was received with many demonstrations of joy. The Gallican church was restored in 1801, but Bonaparte took care that the management of it should belong to himself, not to the pope. In 1809, Bonaparte caused the papal territory to be united to his own empire of France, and fixed the pope's revenue at two millions of francs; but in 1813 his temporal power was restored, to induce him to sanction the marriage of his spoiler with the daughter of the Emperor of Germany. On the fall of Bonaparte, Pius resumed his authority, and enjoyed a season of repose. He died at Rome in 1823, after a long and eventful life of upwards of eighty years.

PIZARRO, FRANCIS, a Spanish General, distinguished as the discoverer and conqueror of Peru. His birth was humble, and his first entrance into the army was in the capacity of a common soldier. When he had acquired some experience, and some property, by his services in Cuba and Hispaniola, and being of a daring reckless spirit, he and some others embarked as discoverers on the coast of the South sea. The timid natives of these wealthy regions were soon overpowered by the bravery, and overreached by the treachery, of their terrible invaders; and after a series of bloody conflicts, in all of which the energetic and cruel character of Pizarro was conspicuously displayed, they were forced to yield to their conquerors. Pizarro fell himself at last, the victim of conspiracy. See AMERICA and PERU.

PLACENTIA, a city of the north of Italy, in the government of Parma, and capital of the former duchy of Placentia, is situate in a well cultivated country, near the river Po, 33 miles north-west of Parma, and 83 east of Turin. It derives its name, according to Pliny, from the beauty of its situation. It has a university, a theatre, 45 churches, 28 convents, and two alms-houses. The streets, in general, are broad and regular. The great square is adorned with a brass statue of Alexander and another of Renatus IV. both of the house of Farnese, and dukes of Parma and Placentia. The inhabitants, who are famed for their politeness, are about 30,000; and the few manufactures carried on consist principally of silk stuffs, woollen, fustian, stockings, and hats. A great fair is held here every year on the 15th of April, which is much frequented. On the overthrow of the kingdom of Lombardy, Placentia obtained its liberty, which it enjoyed for a very short period; after having frequently changed masters, it was annexed to Parma. Here, in 1746, a decisive victory was gained by the Austrians over the Spaniards and French. In 1796 the French obtained possession of Placentia; and in 1799 a bloody engagement was fought in its neighbourhood between the French and Russians, in which the former were defeated.

PLAGUE.—The consideration of this dreadful and destructive malady, which so often depopulates the cities of the East, and lays waste extensive provinces, has been reserved for the present article; as, for the reasons assigned in the treatise on MEDICINE, it is, happily, no longer ranked among those diseases which, in this country, form objects of domestic or even professional treatment. At the same time, it is in itself so important a subject, and has become so much the object of public interest, in consequence of the late discussion and controversy respecting its principal exciting cause and mode of propagation, that it is entitled to considerable attention, and will be treated of here at greater length than has been thought necessary for more familiar, though scarcely less destructive maladies. Still, in conformity with the plan of this work, the following account is addressed rather to the general than professional reader; and the practical remarks will, it is hoped, be found useful to travellers and mercantile persons, whom curiosity or business may lead to visit or reside in those unhappy countries which are the chief seats of the disease.

*Definition.*—It is scarcely possible to give such a definition of the plague as applies to every case, as it exhibits almost an infinite variety in its appearances and degrees; but perhaps the following may be thought less exceptionable than most of those contained in systems of nosology. The plague is a pestilential febrile disease, running its course very rapidly, and usually accompanied with spots, suppurating glandular swellings, and those inflammatory tumors called *carbuncles.*

The *symptoms* are extremely various in their nature and progress, and are often not easily detected by an inexperienced observer, till the fatal catastrophe puts an end to all doubt and difficulty. The disease usually commences with languor, lassitude, headach more or less acute, dizziness, great muscular weakness, dejection of spirits, sickness at stomach, costiveness, or an irregular state of the bowels, and cold shivering, succeeded by increased heat. These may be called the *precursory* symptoms, and are common at the beginning of most fevers. They may be said to form the first stage of the disease. They are soon followed, and often attended, by other symptoms, which more clearly mark the nature of the complaint,—such as a peculiar appearance of the countenance, anxious but desultory and wandering, expressive of great distress, but also marked by an expression bordering on the ludicrous, distinguished by a tremulous motion of the muscles of the face, and a continual sinking of the eyelids. The eyes are, in general, dull and turbid, or red and fierce, and either fixed or sparkling. The tongue, in most cases, is dry, hard, and furred; but the fur varies much in colour, being sometimes white, yellowish, or of a glassy grey, at others, red, brown, or even black. A bitter taste in the mouth is common, and the appetite is either defective or depraved. To these symptoms are added, hurry of thought, rapid and often incoherent speech, restlessness, and unsteady gait. The state of the pulse is little known, as medical men seldom venture so near a patient as to feel it, and then only through the medium of an oil-skin glove or cabbage-leaf; but where it has been examined, it is described as varying much in velocity and strength, but generally very frequent. Bad cases are marked by anxiety, or oppression at the breast, and delirium, which sometimes amounts to raving madness,—also by violent purging, and hemorrhages, or bleedings from various parts of the body.

*Petechiæ*, or purple spots, are not uncommon, and swellings of the glands, in the groins, armpits, or near the angles of the jaws, called *buboes*, are frequent, though not universal concomitants. They usually appear within 60 hours after the commencement of the disease, and are among the most distressing symptoms, as they occasion severe, often excruciating pain, and a troublesome suppuration. The presence of *carbuncles*, chiefly on the back, mark a high degree of malignity, and add much to the distress of the patient. These appearances complete the second stage.

It would be tiresome and useless to trace the varieties under which this disease appears; and it will be sufficient to remark, that the swellings, or *tokens*, as they have been popularly called, usually follow the fever, though they sometimes precede it, and occasionally appear without any fever; while sometimes no other symptoms appear but a degree of stupor, followed by raging delirium, and very painful glandular swellings.

The plague differs from most of the diseases called *Exanthemata*, or febrile erruptions, and agrees with fever in attacking the same person more than once. Instances are recorded of persons having taken the plague at least ten times; but it is observed, that, in these reiterated attacks, the disease is generally mild.

In Turkey, the plague is distinguished into five or six varieties, according to the appearance or situation of the swellings; and the most common kind is called the *true* or *mother* plague, and is that in which the larger glands are affected.

The *termination* of the disease, in health or death, is not less various than are its symptoms. It sometimes carries off the patient in a few hours after the first appearance of sickness; and the event, in hot countries, is often determined in two or three days. In a few cases it terminates favourably and suddenly by profuse perspiration; but more frequently in cases of recovery, the convalescence is protracted to three or four weeks. Persons, apparently little affected, and walking about on their usual business, have suddenly dropt down and expired; and many die raving mad, from the violence of the *fever*, or acute pain of the swellings.

The distinction of plague from other diseases attended with fever, depends rather on the nature of the prevailing disease, in the place or country, than on any particular symptom, or assemblage of symptoms, usually supposed peculiar to itself. It might be confounded with typhus or yellow fever, were it not found that those diseases scarcely ever occur when the plague is raging. In fact, the plague is a tyrannical disease, which aspires at undivided empire. Wherever it spreads its baneful influence, it makes the inferior ministers of death hide their diminished heads, as a blazing meteor eclipses the stars and planets that lie within its course. A patient who dies during a visitation of the plague, if not from age or accident, is said to have died of plague though he had exhibited no other symptom than a dull and turbid eye. This appearance, with the peculiar cast of countenance already described, and the state of the tongue, is regarded as forming the most distinguishing characteristic. The glandular swellings are an additional but not a constant or certain mark, and they are occasionally seen in typhus, of which, indeed, the plague has by some been imagined only an aggravated form. The carbuncles, when present, are considered a sure diagnostic.

Though this pestiferous scourge of mankind has, at different times, visited the greatest part of civilized Europe and Asia, it is more peculiarly confined to what now constitutes the Turkish empire and its tributary states. Egypt, Barbary, and Asiatic Turkey, are particularly the seats of its visitation; and many cities and ports of the Levant, as Alexandria, Cairo, Constantinople, Smyrna, and Aleppo, are seldom entirely free from it. The frosts of Lapland and Siberia, and the scorching heats of central Africa, seem equally inimical to its existence; it seldom appears in Persia, and in the East Indies and America it is unknown. Individual cases of the disease may occur at any season of the year; but its ravages are, in general, confined to certain periods. In the east, it usually begins in March and April, and ceases in July or August; though the natives have a superstitious notion that it must terminate on the 24th of June, or St John's day, and this does occasionally happen. When it has visited Europe, its usual period has been from July to November. It attacks persons of all ages, and both sexes.

*Causes.*—It is easy to enumerate the circumstances which precede or accompany the plague; but to trace their natural relations, as cause and effect, or arrange them under the usual heads of *predisposing* and *exciting*, is a matter of no small difficulty, as these points are still disputed, and what are ranked as predisposing causes by some writers, are deemed exciting causes by others; and while the greatest part of the medical world consider contagion as the principal, if not the only exciting cause, some affirm that this agent has no existence, or exerts no influence in the plague. It is generally allowed that the plague is most likely to arise and spread in large cities, where the houses are small and ill ventilated, the streets narrow, and the population crowded, and where little attention is paid to cleanliness. A particular state of the atmosphere, not distinctly marked, but usually described as close, warm, and moist, or a long continuance of southerly winds, with moist and cloudy weather, is also found to favour this disease. Certain personal circumstances, as debility, imperfect or unwholesome nourishment, want of cleanliness, the depressing passions, and, above all, a dread of the contagious nature of the disease, are by most writers ranked as predisposing causes. On the other hand, it is believed that sea air is unfavourable to plague, as it seldom occurs on board ship, unless brought thither from the shore, and European, and especially English sailors, are almost exempt from it, except they have taken it on shore. It is remarkable that those persons who are employed at quarantine establishments, to examine and purify the cargo of suspected ships, are scarcely ever affected. The same remark holds with respect to oil porters, curriers, and others much employed in greasy occupations.

The question, whether contagion be an exciting cause of plague, has of late been warmly agitated, and many plausible arguments are adduced on either side. In support of the doctrine of contagion, it is argued, that the attack of plague is not simultaneous, but successive; that it commences in one part of a town or district, and gradually spreads to the rest, though under a similar atmosphere, and influenced by the same predisposing causes; and that, in many cases, it has been distinctly traced to communication with affected persons, or to clothes or goods, which have been worn or handled by persons so affected. To these arguments, is added the general belief, in all ages and countries, that plague is a contagious disease. On the other side, it is alledged, that numerous instances have occurred of persons who have slept in the same bed with patients who have died of the plague, and of others who have worn the clothes of the deceased, without receiving the disease; that those who are employed as attendants on the sick, as purveyors, or in burying the dead, and who must be exposed to the full influence of contagion, did it exist, very commonly escape; and that so far from the belief in the doctrine of contagion being general, it is not alluded to by Hippocrates, Celsus, and other eminent medical writers among the ancients, and is almost universally discredited by the natives of plague countries. It is a remarkable fact, that the clothes of persons who have died of the plague, are openly exposed for sale in the streets of Smyrna, and other cities of the Levant, and fearlessly worn by the Mahommedans, and that during the invasion of Egypt, at the commencement of the present century, the Turkish soldiers dug up the dead bodies of those who had fallen victims to the plague, and appropriated the clothes stripped off them, without receiving or communicating the disease, though it was then raging in the country. Some experiments have been made in innoculating for the plague, partly with the view of diminishing its fatality, and partly for the purpose of setting at rest the great question about contagion. The instances recorded are too few to answer either purpose. M. Desgenettes tried it without effect; and Dr White of the British medical staff in Egypt, inoculated himself three times, twice without effect, and though he died soon after the third attempt, it is uncertain whether he derived the disease from the matter thus introduced, or received it in the usual way.

On the whole, we do not hesitate to adhere to the generally received opinion, that the plague is contagious, though not in the degree commonly supposed; that it may originate in the place where it appears, but is communicated by contact with an affected person, or by breathing the same atmosphere with him, provided that atmosphere be confined, as in a close apartment; but that there is little risk of being infected in the open air, or from the effluvia of clothes and goods. That a person should sleep with another without receiving the contagion, is not more surprising or anomalous than similar instances in the small-pox or scarlet fever, which are generally allowed to be contagious, or in typhus, whose contagious nature, like that of plague, is disputed.

*The nature of the disease* is another controverted point. Some, with Mead and Cullen, arrange it among the *Exanthemata* or febrile eruptions, and consider the buboes as similar to the pustules in small-pox; while others, as has been already mentioned, regard it either as an aggravated form of typhus, or as a pestilential fever of the same kind. This last opinion seems to us the most plausible; and we have accordingly, in the treatise on Medicine, ranked plague along with typhus, though we consider it a distinct disease.

*Prognosis.*—The plague, when left to itself, is proverbially a dangerous and fatal disease, and it is calculated that under those circumstances nine patients out of ten die; but it is affirmed by one of the principal modern writers on the subject, that, with proper treatment, the majority of cases would recover. The circumstances indicating a favourable turn of the disease are, the eyes growing clearer, and the vision more distinct; the tongue becoming cleaner, or exhibiting a glossy grey colour; the intellects remaining undisturbed, or the delirium being slight; the mild and early suppuration of the glandular swellings, and in general the mildness of the other symptoms. The unfavourable signs are, high fever, anxiety, great depression of spirits, raving delirium, glazed eyes, foul and dark-coloured tongue, fretted evacuations, and hemorrhages. Little can be judged of with respect to the degree of strength, as patients have been seen suddenly to expire, while walking about in seeming comparative health. The greater or less fatality of the disease prevailing in any particular situation, will, in some measure, regulate the prognostic; as in the former case the hope of recovery is small, while in the latter it may be reasonably expected according as the symptoms are more or less mild.

*Treatment.* — In considering the treatment of plague, the trite, though true maxim, that prevention is better than cure, is more applicable to this than perhaps any other disease. Experience shows, that, by attending to the circumstances above mentioned, by avoiding those which tend to produce the disease, or favour its propagation, and by separating the infected from the healthy on the first appearance of sickness in the former, the invasion of plague may be prevented, or its progress checked. Instant removal from the seat of the disease, to a purer, drier, and more wholesome atmosphere, where circumstances admit of its being adopted, is the first and most effectual step. A sea voyage to a more salubrious climate would be particularly advisable, were it not for the inconveniences of quarantine, to which the voyagers would be exposed on arriving at their destined port; to which may be added the risk of meeting the disease on board. Persons whom necessity obliges to remain in a place where the plague has appeared, should confine themselves and their family entirely to the house, after laying in a sufficient store of provisions, fuel, and other necessaries for a long imprisonment, and avoid all immediate communication with the other inhabitants. Even the air of the street is to be excluded by securing the doors and windows, while internal ventilation is maintained by ventilators in the roof and artificial heat. Domestic and personal cleanliness must be strictly enforced; clothes and bedding should be daily aired in a large upper apartment, provided with a fire-place or stove; and the rooms occupied by the family should be frequently fumigated with tobacco smoke, gunpowder, strong vinegar, or muriatic acid. When occasional communication cannot be avoided, the following measures adopted by the Christian residents at Tripoli, and extracted from Tully's interesting Narrative, referred to at the end of this article, merit particular attention, especially from those who regard plague as a highly contagious disease.

"The hall on entering the house is parted into three divisions, and the door leading to the street is never unlocked but in the presence of the master of the house, who keeps the key in his own possession. It is opened but once in the day, when he goes himself as far as the first hall, and sends a servant to unlock and unbolt the door. The servant returns, and the person in the street waits till he is desired to enter with the provisions he has been commissioned to buy. He finds ready placed for him a vessel with vinegar and water to receive the meat, and another with water for the vegetables. Among the very few articles which may be brought in without this precaution is cold bread, salt in bars, straw ropes, straw baskets, oil poured out of the jar to prevent contagion from the hemp with which it is covered, sugar without paper or box. When this person has brought in all the articles he has, he leaves by them the account, and the change out of the money given him, and retiring shuts the door. Straw previously placed in the hall is lighted at a considerable distance, by means of a light at the end of a stick, and no person suffered to enter the hall, till it is thought sufficiently purified by the fire; after which a servant with a long stick picks up the account, and smokes it thoroughly over the straw still burning, and locking the door returns the key to his master, who has been present during the whole of these proceedings lest any part of them should be neglected, as on the observance of them it may safely be said the life of every individual in the house depends."

This part of the subject is considered the more fully, because it is allowed on all hands to be one of the most efficacious, though its advantages are differently explained by the contagionists and their opponents; the former contending, that this shutting up of houses prevents the introduction of contagion, the latter that it excludes the pestilential atmosphere. In addition to the seclusion from the society of the place, certain personal precautions are proper, such as generous but temperate diet, smoking tobacco, and endeavouring to preserve cheerfulness and equanimity. These precautions are still more necessary to persons who are compelled to go abroad during the plague. Such persons should have a distinct dress for that purpose, which they should change before entering their house, and air or fumigate before putting on again; and if they are likely to come in contact with infected persons, they should wear an oil-skin cover over their clothes, and oil-skin gloves, and they should keep to windward of those with whom they deal or converse.

Shutting up the houses of infected families has been commonly resorted to in Christian countries, as a measure of police, to prevent the inmates from spreading the contagion. Such a measure, could it be strictly enforced, would doubtless be of advantage to the rest of the community; but the distress which it occasions to the inhabitants of the locked-up houses is so great, that it would be preferable to provide a sufficient number of *pest-houses*, out of town, to which patients might be removed on being affected.

*The cure* of plague is not yet sufficiently understood; but reasoning from its analogy with typhus, the following general plan seems as likely to succeed as any we have seen; opening the bowels gently at the commencement of the disease, and bleeding if the feverish symptoms be violent; shaving the head, and bathing it frequently with vinegar and water; leeches, cupping, or blisters to the head or neck, if the former be much affected; keeping the patient in a roomy apartment, occasionally fumigated with vinegar or muriatic acid; sponging or washing the body when the heat is considerable, otherwise rubbing it once or twice a-day with olive oil, mixed with oil of turpentine, applied briskly with a sponge, and giving camphor internally, and wine during the low stage, and promoting the suppuration of the glandular swellings with poultices or fomentations.

*Historical notices.*—After this account of the plague, and the opinions respecting its causes, it will not be uninteresting to add a few historical notices of its more remarkable visitations in different ages and countries, and a brief sketch of its last appearance in this country in 1665.

Egypt has always been regarded as the primaeval nursery of plague; and there is little doubt that one of those remarkable punishments inflicted on that country just before the *exodus* of the Hebrews, and emphatically called "the *plagues* of Egypt," was a disease of the same nature with the modern plague. That plague is commonly reckoned as the sixth. It appeared in the form of a *boil*, breaking forth with *blains*, upon man and upon beast; it attacked, though it did not destroy, all the Egyptians, and, like many of the plagues recorded in profane history, it was preceded by a very grievous *murrain* or pestilential disease among the cattle. Exodus, ch. ix. Not to dwell on the plague, so admirably described by Homer, as breaking out in the Grecian camp at the siege of Troy, and appearing first on beasts and then on men, and several pestilences of the same kind in the Roman territories, during the monarchy and republic, the first remarkable occurrence of plague, recorded by authentic profane historians, is that of Athens, during great part of the Peloponnesian war, about 430 years before Christ, and described by Thucydides. The city was then crowded with inhabitants, great numbers of whom fell victims to the pestilence. About 400 years B. C. the city of Carthage was nearly depopulated by a dreadful plague. At the siege of Syracuse, by the Romans under Marcellus, B. C. 213, great havoc was committed by pestilence among the troops, and all the Carthaginians perished with their generals. About 126 B. C. the northern coast of Africa was visited by a plague which carried off above 1,000,000 persons.

Very soon after the commencement of the Christian era, A. D. 14 or 16, the eastern Roman provinces, and especially Asia Minor, were afflicted with a terrible plague, and 12 cities were at the same time overthrown by earthquakes. The next remarkable visitation of this nature was about A. D. 80, just after the tremenduous earthquake which buried the cities of Herculaneum and Pompeii. It raged particularly at Rome, where 10,000 persons perished daily. Towards the end of the first century a pestilence occured in Britain, and destroyed in Scotland alone 150,000 persons; and in 114 a similar pestilence in Wales carried off 45,000. In 211, the plague prevailed in London. In the middle of the 3d century the plague raged for many years over great part of Europe and Asia, and so depopulated Scotland that, it is said, scarcely living persons were left sufficient to bury the dead. It is uncertain whether these destructive pestilences which occurred at these early periods strictly deserve the name of *plague*; but the visitations now to be noticed are universally allowed to be of that description. About the middle of the 6th century a plague arose in Egypt, and spread successively to Palestine, Syria, and Constantinople, and thence to almost every part of the known world. It continued to rage in various places for about 50 years, carrying havoc and desolation wherever it appeared, depopulating alike villages and cities, and threatening the destruction of the whole human race. In the middle of the 8th century, Constantinople was left almost without inhabitants, and the emperor Constantine was obliged to repeople it from the neighbouring countries.

During the crusades, in the 12th and 13th centuries, the plague appeared repeatedly in Asia and Africa, and occasionally in Europe, brought thither, it is supposed, by the soldiers of the cross. Another universal and destructive plague, spreading successively from China to the north of Europe, raged from 1345 to 1349 and swept away one-third of the western world. England and France shared in this visitation; and while their ambitious monarchs, Edward and Philip, were sacrificing thousands of their subjects in their contest for superiority, pestilence carried off still greater numbers than fell by the sword. In London alone, 50,000 bodies were buried in one church-yard. From that fatal epoch to 1665, England was several times assailed by this formidable scourge, and London suffered considerably. In 1593 that capital lost by the plague 11,500 persons, in 1603, 36,269, and nearly as many fell victims to it in 1625. In 1636 it carried off 13,480 persons; but the greatest, and happily the last, mortality from this disease was in 1665, when, on a moderate computation, nearly 70,000, some say 100,000 persons, perished of the plague in London.

In 1720 occurred the last plague that visited Marseilles, and destroyed about 60,000 of the inhabitants. In 1771, Russia, and especially Moscow, was attacked by the plague, and 62,000 persons perished. In 1770 the plague was so destructive at Constantinople, that 200,000 people died of it from May to July. In 1784-5 the cities of Tunis and Tripoli, in Barbary, were nearly depopulated by the plague, and in 1779 and 1800 it committed great havoc at Morocco. In 1812 and 1813, the plague raged along the shores of the Levant, and Constantinople suffered still more than in 1778. In 1813 it reached Malta, where it had not before appeared for 130 years. It was particularly severe at Valetta, and carried off many of the British troops then in garrison on the island. In 1818 it visited Venice, and in 1819 it attacked Nuremburgh.

*Great Plague of London.*—The origin of the last plague at London in 1665, pre-eminently called the *Great Plague*, is involved in mystery. The former pestilences of the same century were, with some plausibility, traced to communication with infected places on the continent, and much pains was taken to impress the public with a belief that this plague had a similar origin, namely, from the importation of infected bales of cotton or hemp from the Levant, through the medium of Holland; but this fact has never been established, and there are good reasons for believing that, on this occasion, the disease originated in London. If the state of the city at that time be considered, the streets narrow, close, and dirty, the houses small and badly ventilated, with the filth of many years accumulated in the privies, no common sewers to carry off nuisances, and a population crowded to excess by the residence of a licentious and luxurious court, with its numerous followers and retainers, it is not surprising that a malignant pestilential fever, or plague, should have broken out, and spread with unexampled fury.

The plague first shewed itself, by two or three insulated cases, in the parish of St Giles, Westminster, at a distance from the mercantile part of the city, and two persons died of it there in December 1664; but the severe cold of the winter rendered the contagion dormant till February 1665, when a few more cases appeared, and others in April. In May it became more general, and in June had assumed so formidable an aspect that about two-thirds of the inhabitants fled from London, and retired to distant and healthy parts of the country. The court were among the first to quit the scene of desolation, and retreat to Oxford, whither they were followed by the Parliament, the courts of justice, and many of the gentry, merchants, clergymen, and even medical practitioners, crowded to the country, and the deserted city, instead of the bustle of commercial activity and the concourse of splendid equipages which it had lately displayed, exhibited empty grass-grown streets, and houses with closed window-shutters, or converted into prisons, with the doors marked with a red cross, and guarded by watchmen. A melancholy stillness prevailed, interrupted, during the day, only by the frantic exclamations of miserable wretches, seized with delirium or abandoned to despair, or the piercing lamentations of those who had just seen their dearest relations expire. All places of public amusement, and even many of the churches, were closed, and almost all business was suspended. As the disease reached its height, the mortality increased so much, that the usual forms of burial could no longer be observed. The dead bodies were conveyed by cart-loads to the church-yards, and thrown promiscuously into enormous pits, capable of containing several hundreds, and only imperfectly covered till the pit was nearly full. The rumbling of the *dead-carts*, which nightly made their melancholy round, and the hoarse summons of the bearers for the inhabitants to *bring out their dead*, rendered the evening still more dreadful and appalling than the day. The general calamity was aggravated by the depredations of desperate ruffians, who not only plundered the deserted houses and warehouses, and dwellings that had been untenanted by the plague, but even made their way into some whose inhabitants were rendered defenceless from disease, carried off their most valuable effects, and, it is said, not unfrequently murdered the wretched beings who ventured a feeble resistance. Even watchmen who guarded the doors of infected houses, and nurses who waited on the sick, were accused of similar enormities. To those bolder robberies were added the cheats and impostures of conjurors and astrologers, who pretended to predict the fate of credulous people, and of impudent quacks, who sold *infallible* preventives or remedies for the plague, and probably poisoned many whom the disease might have spared.

In this dreadful situation, London remained for nearly six months; and during that period about one-half of the remaining population perished. The plague had gradually spread from Westminister to the city and liberties, and thence to Wapping, Blackwall, and the adjacent hamlets. There it arrived in October, and there it made its last stand, and, declining by degrees, finally subsided in December.

It is often asked why the plague, which, in the course of little more than 70 years, visited Britain 5 times, and destroyed nearly 200.000 persons, has not appeared in this country for 160 years. To explain this happy circumstance, it is alleged, that the state of our cities, or of society in general, has, during that time, been greatly improved, so as to remove many of those causes which formerly favoured the propagation of plague, and that the strict enforcement of our quarantine laws has prevented the introduction of that contagion. Whether this last cause of exemption can be allowed much weight, it is difficult to decide; and, on considering the first, it is not easy to explain why some of the continental cities of Europe, as Paris, Lisbon, and Madrid, where improvements in building, police, and society, have not made the same progress as in London, have been equally exempted. Some writers suppose that much is to be attributed to a favourable change of the atmosphere, and to the greater consumption of pit-coal in London and other large cities.

For farther information on this subject, see Hodge's *History of the Plague in London*, 1720; Mead *on the Plague*, 1744; Russel *on the Plague*, 1795; Assalini *Observations sur la Peste*, 1805, or the English translation by Neale; Webster's *History of Epidemic and Pestilential Diseases*, 1800; Tully's *Narrative of a ten years residence in Tripoli*, 1817; Sir Arthur Brooke Falkner's *Treatise on the Plague*; Maclen's *Result of Investigation respecting Plague, &c.* 1818; Hancock's *Researches on Pestilence and Plague*, 1821; *Report of the Select Committee of the House of Commons on the Contagion of Plague*, 1819; and *History of the Great Plague in London*, 1819. See also POISONS and QUARANTINE.

**PLANETARIUM**, first known by the name of *Orrery*, is an astronomical machine which illustrates the appearances and motions, orbits, and positions of the heavenly bodies, according to the Copernican system, or as they are in nature. A description of this apparatus will be found under the article ASTRONOMY, as represented in Plate 23, Figs. 12, 13, and 14. The principal use of the planetarium or orrery, is to illustrate the theory of the earth and moon, and to render it obvious and intelligible,—to exhibit to our senses the manner in which all these changes and phenomena take place, which depend on the annual and diurnal revolution of the earth, and the monthly revolution of the moon. It is so constructed, therefore, as to represent all the variety of the seasons; the vicissitudes and lengths of days and nights, also the nature of eclipses of the sun and moon, and various other phenomena. By means of this apparatus many individuals who have not sufficient leisure to apply themselves to the study of astronomy, may, in the course of a short time, attain to a complete knowledge of several of the most remarkable appearances of the heavenly bodies, which otherwise might remain to them mysterious and inexplicable. Various forms of this instrument have been invented; but of these, the two that have been most approved of are the whole and the half sphere planetarium. At first this machine appears to have been constructed without any sphere, and with nothing more than the sun having the earth and moon revolving around it; but soon after it was invested with half a sphere, and then with a whole sphere, in order to exhibit a more full and correct representation of the celestial bodies, and of the whole solar system.

For the invention of the orrery, we are indebted to Mr Rowley, an eminent mathematician of Litchfield, who named it after his friend the Earl of Orrery, whose family had long been the distinguished and liberal patrons of almost every art. An improved instrument of this kind was also invented by Mr Huygens, and is still preserved in the University of Leyden. It represents the revolutions of the five primary planets about the sun, and that of the moon about the earth, so that the situations of the planets with their conjunctions and oppositions, are clearly seen and discovered for any time past, present, or to come. In 1791 a much more accurate and elaborate machine of this sort was exhibited in London, representing all the most remarkable motions, revolutions, and phenomena of the universe. This stupendous piece of mechanism exhibited the whole phenomena of the solar system, with the satellites of the earth, Jupiter, and the other planets, preserved in constant motion by a chronometer, even to the very diurnal rotation of the planets, and the unequal motions in their elliptic orbits. The merit of this wonderful machine is due to the celebrated M. Hahn, of the academy of Sciences at Erfurt, who left it unfinished, but it was afterwards completed by M. A. de Mylius. This noble instrument was purchased by the English government, and sent out with Lord Macartney, among other curiosities of his embassy, as a present to the Emperor of China.

PLANING MACHINE, an engine for effecting the operation of planing timbers, boards, &c. General Bentham is said to have been the first who attempted to produce a planing machine, and he took out a patent for his invention in 1791. The object of the ingenious projector was to free the joiner from the charge he had of his tool in the laborious operation of planing, by so adjusting the cutting iron, that it could not but perform the operation intended without requiring any of the skill of the workman, thereby rendering a common labourer equally as serviceable as the best joiner for this purpose. He was not so successful, however, as he had anticipated. Though General Bentham's machine possessed several advantages in comparison with the manual operation of planing, it was far from being so perfect or so powerful an engine as seemed necessary where considerable works were going forward. A very superior engine of this kind was invented in 1802, by the late Mr Bramah. In this planing machine the operation was performed by the rotation of a vertical spindle and a horizontal wheel furnished with cutters and planes. A machine of this kind was erected on Mr Bramah's own premises at Pimlico, where it is still in action, and a second, which differs in some important points from the former, was set up in the Royal Arsenal, Woolwich, and which has been since much improved by the ingenuity of General Millar, the superintendant of the carriage department in that establishment. This excellent machine was kept in constant employment during the late war, when there was great demand for gun-carriages, but it is now seldom in operation.

PLANT is an organic vegetable body, composed of a root, stem, leaves, flowers, fruits, and seeds, which attaches itself to other bodies, so as to draw from them its nourishment, and to propagate itself by seeds. Of the structure and functions of plants and vegetables,—of their perspiration and sleep,—of their germination, food, heat, colour, and decomposition,—an ample account has already been given in this work under BOTANY and CHEMISTRY. Our knowledge of the economy of plants, and of the principles of vegetation, till within these few years, has been extremely limited; and to this circumstance probably may be ascribed the great fluctuation of our theories, and the diversity of our opinions upon this subject.

*Analogy between plants and animals.*—Mr Good, in a very learned and ingenious essay, delivered in presence of the Medical Society of London a few years ago, "On the general structure and physiology of plants compared with those of animals, and the mutual convertibility of their organic elements," brings forward much curious matter and many interesting speculations. He assumes, what philosophers in general have admitted, that every thing possessed of life is produced from an egg, and that the seed of the plant is the egg. This seed consists of a corculum or little heart, which is "the *punctum saliens*" of vegetable life; and hence originate the radicles, which chiefly are composed of lymphatics and air vessels which serve the purpose of separating the water from the soil, that the oxygen may be separated from the water. In the trunk is to be found a cellular substance, which contains vessels that may be compared to veins and arteries, air vessels, and lymphatics. In the cuticle, and immediately under it, lie the lymphatics, which, separating in different directions, are capable of performing the functions of inhalation and exhalation. By the arteries which lie below these, and which immediately proceed from the roots, the nutriment of the plant is communicated in a perpendicular direction. The veins being softer and more numerous, are situated within these, and between the veins and arteries lie the air vessels.

"The lymphatics of a plant," says this ingenious writer, "may be often seen with great ease, by merely stripping off the cuticle with a delicate hand, and then subjecting it to a microscope; and, in the course of the examination, we are also frequently able to trace the existence of a great multitude of valves, by the action of which the apertures of the lymphatics are commonly found closed. Whether the other systems of vegetable vessels possess the same mechanism, we have not been able to determine decisively; the following experiment however should induce us to conclude that they do. If we take the stem of a common balsamine, or of various other plants, and cut it horizontally at its lower end, and plunge it so cut into a decoction of Brazil wood, or any other coloured fluid, we shall perceive that the arteries or adducent vessels, as also the air vessels, will become filled or injected by an absorption of the coloured liquor, but that the veins or reducent vessels will not become filled, of course evincing an obstacle in this direction to the ascent of the coloured fluid. But if we invert the stem, and in like manner cut horizontally the extremity which till now was uppermost, and plunge it so cut into the same fluid, we shall then perceive that the veins will become injected or suffer the fluid to ascend, but that the arteries will not—proving clearly the same kind of obstacle in the course of the arteries in this direction, which was proved to exist in the veins in the opposite direction; and which reversed obstacles we can scarcely ascribe to any other cause than the existence of valves. By this double set of vessels, moreover possessed of an opposite power, and acting in an opposite direction, the one to convey the sap or vegetable blood forwards, and the other to bring it backwards, we are able very sufficiently to establish the phenomenon of a circulatory system."

Although the existence of nervous or muscular fibres in plants has never been discovered, yet this author observes that we must admit the competency of other powers to produce the same results; and he next proceeds to illustrate the striking resemblance in the functions and habits of plants to those of animals, observing, that in general they are propagated by sexual connection, that the blood of plants is compound, and consists of numerous compacter corpuscles,—that like animals they secrete a great variety of different substances, frequently possessing different and opposite powers and qualities,—substances nutritive, medicinal, or destructive;—that plants are likewise liable to numerous diseases, endemic, sporadic; to scabies, pernio, ulcer, gangrene, and many other diseases to which plants are subject in common with animals; and that they may likewise be regarded as locomotive or migratory, of which the strawberry is a familiar example. Mr Good further observes, that plants, like animals, may be divided into the three classes of terrestrial, aquatic, and aerial; that they have a wonderful power of preserving their common temperature, and are found to exist in astonishing degrees of heat and cold. Some of them are amphibious, and others are aerial, and will only grow in sands from which no moisture can be extracted. Of this latter species is the aerial epidendrum, a native of India, "where the inhabitants often pluck it up on account of the beauty of its flower, the elegance of its leaves, and the exquisite odour it diffuses, and suspend it by a silken cord from the ceilings of their rooms, where from year to year it continues to put forth new leaves, new blossoms, a new fragrance, excited alone to new life and action by the stimulus of the surrounding atmosphere." This author observes, "that however torpid a seed may be, and destitute of all power to vegetate in any other substance, if steeped in a diluted solution of oxygenated muriatic acid, at a temperature of about 46° or 48° of Fahrenheit, provided it still possess its principle of vitality, it will germinate in a few hours." He farther shews, that animals and vegetables agree in their equal necessity of extracting a certain sweet and saccharine fluid as the basis of their support, from whatever substances may be applied to their respective organs of digestion. To preserve the balance of nature in a state of equipoise, he likewise shews by what means animal matter is reconverted into vegetable, so as to afford to plants the same basis of nutriment which plants have previously afforded to animals. This principle is the process of putrefaction, which he regards as an important link in the great chain of universal life and harmony.

*Circulation of the sap.*—The vegetable sap or juice of plants has been generally supposed to maintain a circulation analogous to the blood of animals; to ascend by one set of vessels like those of the arteries, and to descend by another like those of the veins. But, fully to demonstrate the existence of two sets of vessels, it would be necessary to prove that in plants, as in animals, there is a kind of focus or centre to which the circulation tends, and from which it begins; but, so far as the discoveries of botanists hitherto have reached, nature has not made the smallest provision by which the sap might be prevented from descending in the the very same vessels by which it ascended. Others, therefore, have affirmed, that the vegetable sap in plants only ascends during the day, and as regularly descends again, in the very same vessels, during the night. The learned Dr Hales has endeavoured to argue against this doctrine, and to prove the reverse by numerous experiments. "The defect of circulation in vegetables," says he, "seems, in some measure, to be supplied by the much greater quantity of liquor which the vegetable takes in than the animal, whereby its motion is accelerated; for we find the sun-flower, bulk for bulk, imbibes and perspires 17 times more fresh liquor than a man, every 24 hours."

"If the sap be circulated," says he, "it must needs have been seen descending from the upper part of large gashes, cut in branches set in water, and with columns of water pressing on their bottoms in long glass tubes. But it is hard to conceive what and where that power is which can be equivalent to that provision nature has made for the ascent of the sap in consequence of the great perspiration of the leaves. The instances of the jessamine tree, and of the passion-tree, have been looked upon as strong proofs of the circulation of the sap, because their branches which were far below the innoculated bud were gilded; but we have many visible proofs in the vine, and other bleeding trees, of the sap receding back and pushing forwards, alternately, at different times of the day and night. And there is great reason to think that the sap of all other trees has such an alternate receding and progressive motion, occasioned by the alternacies of day and night, warm and cold, moist and dry." The sap in all vegetables does very probably recede, in some measure, from the tops of the branches as the sun leaves them; because its rarifying power then ceasing, the greatly rarified sap and air mixed with it will condense, and take up less room than they did, and the dew and rain will then be strongly imbibed by the leaves, for by several experiments, plants were found to increase considerably in weight in dewy and moist nights.

Since the time of Dr Hales, this question has been frequently agitated, and has given rise to much controversy and speculation. Considerable advances have been made in vegetable physiology, which it is necessary to mention, however cursorily, before proceeding to give an account of the recent opinions on this subject. The doctrine of the diurnal ascent and descent of the sap has been given up. It has been shewn to flow in a continual stream of varying abundance, from the beginning of spring till the middle of autumn. Mr Knight has demonstrated by experiment, that it ascends along the alburnum and adjacent layers of wood, and not through the bark as was formerly supposed; and farther, that it is conveyed into the leaves by means of channels or central vessels, as he calls them, existing in the footstalks. Thus, when he removed rings of bark of the breadth of half an inch, from the trunks of a number of crab trees, they still continued to grow, but when he cut through the alburnum the sap was intercepted and the trees perished.

The cause of the ascent, or the impelling force of the sap, which Dr Hales found in some instances to be equal to a column of water 43 feet high, has not as yet been ascertained; for, although many theories have been proposed, which make it depend on the expansive power of heat, the inherent irritability of the vessels, the dilatation and contraction of certain fibres, and even on the *necessity* of ascension, no decisive experiments have hitherto been made.

During the whole progress of the sap towards the extremities, a process of elaboration goes on, which assimilates the crude juices afforded by the roots to the peculiar substance of the plant. This, however, is not perfected until it reaches the leaves, where a complicated chemical action takes place, the result of which seems to be, that carbonic acid, formed of the oxygen of the atmosphere and the carbon of the plant, combines with the watery part of the sap, and thus produces the *cambium*, or proper juice. In its ultimate state of perfection it is of various colours, such as white in the fig, red in sanguinaria, yellow in celandine. It then begins to descend through the bark, or rather between the bark and the wood, effecting, in its progress, by a kind of deposition, a new layer of alburnum, with its vessels and other additional parts. This descending motion of the sap has also been proved by experiment. It is found, that trees, within a given time, increase in magnitude on the upper side of a tight ligature, while there is no perceptible enlargement below. Mr Knight stripped off two rings of bark from the branch of a tree, and preserved a leaf at an equal distance from each. The bark on the upper side shrivelled and died, while that below, receiving the elaborated juices from the leaf, continued fresh and plump.

It is the generally received opinion that the whole of the *cambium* is deposited in the shape of alburnum; but Mr Knight contends that a certain portion is held suspended in the cells, and again carried to the extremities during the flow of sap in the following spring. In support of this conclusion, however probable it may seem, he has advanced nothing more than a few arguments of rather an ambiguous character. And, even if he had succeeded in proving this mode of circulation, he would not have refuted the opinions of Dr Hales, who merely attempts to shew that the flow of the sap has little or no analogy with the rapid and incessant movements of the blood.

*Motion and perpendicularity of plants.*—Motion, when applied to plants, denotes not so much a change of place as of direction, indicating that the roots always run directly or transversely downwards, and the stems in a contrary direction,—so that a plant taken out of the earth, and replanted with its roots uppermost, and the stem lowermost, each of them will resume its natural direction. Some authors, as M. de la Hire, supposes that the roots of plants draw a coarser and heavier juice, and the stem and branches a finer and more volatile one. If the heavier juices, therefore, pressing the root more and more, force it downwards, for a similar reason the volatile juices, having penetrated the stalk, will give it a direction upwards, and the stem of the plant, if it meet with no obstruction, will thus become perfectly erect. Others conceive the root to be the stomach of the plant, in which the juices of the earth become so changed and subtilized, as to rise through the stem to the extremity of the leaves and branches. If this subtile nutricious juice reach the top of the stalk, congeal and fix upon the extremity of the stalk, the weight of the air will give it a perpendicular direction, like mercury in a barometer, so that the extremity of the stalk will constantly acquire a new part laid over it, or added to it in the same direction. The branches, which at first proceed in a horizontal direction to the stalk, must, by the action of the nutritious juice, likewise tend upwards; but being attracted at length by the light and air, they nearly proceed in the angle of 45° with the stem and each other, unless when influenced by other causes. The air, light, and sun thus contribute to the direction, and therefore generally to the perpendicularity of the stem, whilst the air and warm moisture concur in giving the contrary direction to the roots. A plant placed in a room which admits light only by a single aperture, will uniformly incline towards the light; and in very thick forests young trees always do the same. Even the young branches of trees detach themselves from the wall, and abandon the direction of the stem in quest of the air, light, and sun. The roots in like manner penetrate into the soil, either horizontally, or in a perpendicular direction, in proportion to their greater or less tendency to search for moisture; so that in the vicinity of ditches and canals filled with water, many plants abandon their natural course, and move towards the grateful humidity and fine air and juices which this situation enables them to enjoy; and so powerfully are the roots of some plants attracted by water, that they frequently abandon their natural direction, and penetrate the hardest soils, into the very bottom of canals and ditches, and even pierce into walls and overturn them. If, however, the natural course of a plant be forcibly controlled, it either recovers its natural position, or dies outright. Hop plants growing round a pole from east to west, following the course of the sun, are of this description. If untwisted and confined in the contrary direction they die; but if any of them be left loose, it will by sunrise next morning recover its original position. In like manner, if you twist the branch of a tree, so that the leaves become inverted, it will return back till the leaves recover its natural situation as to the upper and under side of the leaf. When the root of a tree grows out of the earth it soon alters its course by dipping into the ground anew, and it then continues at its proper depth, and frequently evades obstructions by going round them. Thrust a bean stick into the ground at a short distance from a running plant, and it will stretch towards and embrace the stick and rise up to its top so long as it continues to shoot. In this manner does the honey-suckle advance, and when too tall for supporting itself it shoots spirally, and if no support be within its reach it embraces one of its own kind, the one screwing round the other to the right, and the other in an opposite direction for mutual support; but should any of its shoots come in contact with a dead branch it then turns invariably from right to left. The claspers of briony shoot in the same spiral direction; but when they have made three turns without meeting with any support, they seem to try again by changing their course.

But the stems and branches of plants are not the only parts that move towards the light of the sun and the air, for the flowers also, such as the sunflower, bastard rocket, and dyers weed, often change their position, and have a tendency to follow this luminous body in his diurnal course looking towards the east in the morning, the south at noon, and the west at night. Plants of this species have, from this tendency, therefore been termed heliotropæ, turning with the sun, and their motion has been termed nutation. The hedysarum gyrans, by a seemingly voluntary motion, even when the air is still, whirls its leaves in various directions. Venus' fly trap, the dionæa muscipula, shuts its leaves from the stimulus of insects that alight upon them, and with considerable force pierces them with its prickles. The common sensitive plant, so well known and so much admired, also closes its leaves when any violence is offered to any part of it; and this is so similar to what we observe in animated beings, that the term sensitive plant is very appropriate. In this manner the plant commonly but improperly called the rose of Jericho alternately dilates and contracts, and the motions of such plants are supposed to be occasioned by the dryness of the fibres, which contract when exposed to the heat of the sun.

M. Astruc attempts to account for the perpendicularity of plants, and their redressing themselves, in the following manner. 1. He thinks the nutritious juice arises from the circumference of the plant, and terminates in the pith. 2. That fluids contained in tubes either parallel or oblique to the horizon, gravitate on the lower part of the tubes, and not at all on the upper. The nutricious juice, therefore, in plants which have been placed obliquely or parallel to the horizon, will consequently act more on the lower than on the upper part of the canals, and by this means will insinuate more into the canals therewith communicating, and will be more copiously therein collected, so that the parts on the lower side will be more powerfully nourished than those on the upper, and the extremity of the plant will thus naturally have a tendency to bend upwards.

Considerable changes take place in the direction of the leaves of several plants in the course of the night, or during moist weather. Mr Milne, in his Botanical Dictionary, remarks, that "in that state of the atmosphere which generally precedes a storm, and in a close moist and cloudy air the winged leaves extend themselves along the common footstalks. The same appearance is observed in the leaves of the sensitive plant, when it has been kept for several days in a cellar below ground. After sun-set, and during the fall of the dew, they incline still lower, hang vertically downwards, and are applied closely together like the leaves of a book, by the lower surface under the stalk, with which they stand at right angles. The odd lobe, if there is one, at the extremity of the leaf, folds itself up till it has reached the first pair of lobes or smaller leaves in its neighbourhood. This motion, which Linnaeus calls the sleep of plants, can be produced by an artificial as well as a natural dew. In some simple leaves, a similar appearance is observed. Thus the upper leaves of garden orach approach during the night, unite perpendicularly, embrace the young shoot, and do not relinquish that posture till the sun has dissipated the humidity of the air."

*Degrees and rapidity of growth, and progression in weight and stature.*—Plants, from the time they are inclosed in the seed till the fulness of their perfection, are capable of prodigious increase both in bulk and weight. A single acorn weighing the 12th part of an ounce, in the space of 100 years, with roots and branches, has been computed to weigh about 15 tons, which is an increase of parts equal to nearly seven millions of its original weight; so that, one year with another, it must have gained upwards of five thousand ounces, exclusive of the acorns, leaves and husks it may have produced, from about its 30th to its 100th year; all which weight it must have drawn from the earth, water, and air in that period of time. The weight of a full-grown gourd, compared with that of the seed, and likewise its progressive growth, is supposed to be much the same with that of the oak, in proportion to the length of its life. Professor Bradley of Cambridge reckons a seed to weigh about the 32d part of an ounce; and when the plant arrived at full perfection, he measured from the extremity of one branch to that of another above 30 feet, at which time were growing on it five large fruit, weighing each at an average about 20 lb. with as many smaller ones as might probably weigh 30. The leaves, stalks, and roots he calculated to be about 40lb. so that in six months this plant had gained on the whole about 170 lb. which is upwards of 87 thousand parts of an ounce more than the weight of the original seed; and as he calculated that as it came to its full growth in not longer than 40 days, and as it was 20 inches long and 10 thick, it must have grown half an inch in length and a quarter of an inch in breadth one day with another. As the leaves of the same plant full grown measured about ten inches, and from their state in the bud till fully expanded, required only about seven days, so they must have expanded about an inch and a half at an average every day. He conceives, therefore, that there is no reason why we may not observe that growing motion with the help of a good microscope, since some glasses are so powerful as to magnify a single grain of sand so as to make it appear three inches over. Allowing an inch and a half, then, as the produce of 24 hours, to be equal to 75 points, then in 24 hours the leaf will grow these 75 points, and if each of these points be three inches by the microscope, the produce of 24 hours, or a night and day, is 18 feet 9 inches. He therefore supposes that if a good microscope were fixed over one of these leaves, when the sun shines upon it, the circulation of the sap might be observed, and we might then have the satisfaction of observing the growth of the plant, and see its parts move much quicker than the minute-hand of a clock, and without pauses or rests in its motion.

To promote the rapid growth of plants, Professor Bradley takes notice of the effects of soap on the vegetation of trees, by anointing the roots with it. In his *Philosophical Account of the Works of Nature*, he mentions an instance of an extraordinary quick vegetation in a transplanted bay-tree of an inch diameter in the stem, which, according to the report of a curious botanist, produced in one month 3 branches nearly two feet long, out of the hard wood of the stem. Finding, therefore, the ingredients of soap to consist of ashes, of vegetable oils, of vegetables or fish, or tallow of other animals, he concluded that these might reasonably contribute to vegetation, and the more especially as it was the common custom in some parts of England to manure the land with fish of several kinds, and to lay the carcases of dead animals to the roots of decayed trees to invigorate and restore their health. In consequence of this, the learned professor anointed some cuttings, especially of vines, in June, which preserved the leaves fresh and green, and in August began to shoot. He therefore recommends the use of soap in the removal of plants to any great distance to prevent the roots from shrinking or being dried up by the air.

*Perceptivity and enjoyment of plants.*—Whether plants be capable of sensation, perceptivity, and spontaneous motion, has long been disputed, but has never yet been fully ascertained. From the rising of the sap in plants, from the sex of their flowers, from their general manner of propagation, and the power which many of them possess of assuming a position during the night different from that in which they appear during the day, some philosophers have gone so far as to suppose, that, like animals, they are in some degree capable both of perception and enjoyment. On this subject there have been many curious and interesting speculations; and the learned Dr Percival in particular, in the 2d vol. of the Manchester Transactions, seems to be so fully satisfied of this, as to suppose, that, at some future period it may be discovered, that perceptivity extends even beyond the limits at present assigned to vegetable existence. He observes that corallines, oysters, and sea-pens, are endued with the power of motion in a very small degree, and states that Mr Millar mentions a species of coral in the island of Sumatra, which has by the inhabitants been mistaken for a plant, which appears straight like a stick, but is no sooner touched than it draws itself into the sand. "Now, if self-moving faculties like these, indicate animality, can such distinction be denied to vegetables possessed of them in an equal or superior degree? The motions of the sensitive plant have been long noticed with admiration, as exhibiting the most obvious signs of perspectivity." Many discoveries, indeed, have been made respecting the nature, functions, and habits of plants and animals, and the experiments of Count Marsigli have proved that madrepores, sponges, and corallines, were endued with life, so as to induce him to class them with maritime plants; whereas, on further investigation, Jussieu, Ellis, and Peysonel have been since that time induced to elevate them to a higher class and to rank them with animals. In support of this hypothesis, he considers instinct as operating on the vegetable tribe, and illustrates this from the plumula of the seed always turning upwards, and the radicle striking downwards; from the hop plant invariably following the course of the sun round a pole, from the branches of the honeysuckle strengthening themselves when they become unable to bear their own weight, by changing their form into a spiral, each of them thus seeking, by instinctive impulse, what is agreeable to its natural habits. He mentions various instances of the instinctive powers of vegetables, from which he infers a certain degree of spontaneity, particularly in the case of the *dionæa muscipula.* The Bishop of Landaff has likewise adopted the same opinion in his Chemical Essays, Vol. V. "Whatever can produce any effect," says the doctor, "upon an animal organ, as the impact of external bodies, heat and cold, the vapour of burning sulphur, of volatile alkali, want of air, &c. are found to act also upon the plants called *sensitive.* But, not to insist on any more instances, the muscular motions of the dionæa muscipula, lately brought into Europe from America, seem far superior in quickness to those of a variety of animals. Now, to refer the muscular motions of shell-fish and zoophites to an internal principle of volition, to make them indicative of the perceptivity of their being, and to attribute the more notable ones of vegetables to certain mechanical dilations and contractions of parts occasioned by external impulse, is to err against that rule of philosophising which assigns the same causes for effects of the same kind." In proof of this theory, Dr Percival observes, that the following fact repeatedly occurred to him: "A sprig of mint, suspended by the root, with the head downwards, in the middle glass vessel of Dr Nooth's machine, continued to thrive vigorously without any other pabulum than what was supplied by the stream of mephitic gas to which it was exposed. In 24 hours the stem formed into a curve, the head became erect, and gradually ascended towards the mouth of the vessel; thus producing by successive efforts a new and unusual configuration of its parts. Such exertions in the sprig of mint to rectify its inverted position, and to remove from a foreign to its natural element, seem to evince evolition to avoid what was evil, and to recover what had been experienced to be good." If a plant in a garden-pot be placed in a room which has no light except from a hole in the wall, it will shoot towards the hole, pass through it into the open air, and then vegetate upwards in its proper direction. But might it not be argued with equal force, that a stone is possessed of the same volition and perceptivity, because when thrown up into the air it will uniformly indicate the same qualities by returning again to its natural position of rest upon the ground. This doctrine of Dr Percival is ably confuted by the ingenious Mr Townson, in the 2d volume of the Transactions of the Linnæan society; and he concludes in these words: "When all is considered, I think we shall place this opinion among the many ingenious flights of the imagination, and soberly follow that blind impulse which leads us naturally to give sensation and perceptivity to animal life, and to deny it to vegetables; and so still say with Aristotle, and our great master Linnæus, "Vegetabilia crescunt et vivunt; animalia crescunt, vivunt et sentiunt.""

*Propagation of plants.*—In size and figure plants greatly vary according to their particular kinds, but all of them, however minute, are generally admitted to be propagated by seed, although the seeds of some of them, such as of mosses, fungi, byssus, and some others, are so very minute that they are scarcely perceptible to the naked eye. So easily cultivated are many of the tribes of plants and vegetables, that nothing more is required than to part their roots, and deposit cuttings or layers of the particular kinds, in a proper soil. Some trees are even capable of being propagated by leaves, which contain in themselves such vegetable principles as give them a power of producing as perfect plants as the originals from which they were taken. Professor Bradley, in his Philosophical Account of the Works of Nature, remarks, that if you "plant the leaves of orange trees or other evergreens in fresh earth, they will strike root and produce perfect plants if they are well watered and kept in the shade, as myself and Mr Thomas Fairchild of Hexton, with some others, have experienced; so that leaves, besides their use in helping the buds to germinate, while they are growing upon the trees, may be esteemed perfect vegetable bodies. The leaves of aloes being set in like manner will produce perfect plants, and even the fruit of the opuntia or Indian fig, when it is full grown, being set into the earth, will strike root and become a plant as perfect as the mother it was taken from."

Twigs and branches of trees are really so many plants growing upon one another, or may rather be said to be buds expanded; and from this he infers, that the bud which produced them performed the office of a seed, the twigs taking root in the branches, and the branches in the stem, so that all these, taken separately, may be made by some means or other to take root, and even the very roots themselves, when cut to pieces and planted after a proper method, will vegetate, and become perfect trees.

Some plants may even be propagated without either seed or root, or cuttings or leaves, and whose flowers and seeds have never yet been discovered; and the common mushroom, or champignon, is a plant of this kind. These plants are raised in beds, from small pieces of moldy soil, such as is usually to be found in old dunghills, which is accounted the best, as it most abounds with white cobweb, like veins running through it. This moldy soil, after lying three or four days in the bed, becomes a kind of leaf to the whole, by shooting out its cobwebs over the greatest part of the surface, and at length runs into clusters of small white knots, which in time become perfect mushrooms. That moldiness which appears upon confections and pickles that are damaged, is likewise of this species of fungi.

*Productive powers of plants.*—The number of plants that may be propagated from one seed or individual is truly astonishing. So great indeed is their tendency to multiply, that a single plant almost of any species would in a short time cover the surface of the whole earth. In the common mallow have been found not less than 200,000 seeds, and even 13,824 seeds of the common wall-moss have been taken from a single capsule not more than one-ninth of an inch in length and one twenty-third of an inch in diameter, and whose weight was only the thirtieth part of a grain. M. Dodort, in his Memoirs of the Royal academy of Sciences for 1700, upon the fecundity and increase of plants, states, that from an elm, 12 years old and 20 feet high, he cut off a branch of eight feet long, and found on it 16,450 seeds, and he observes that, as the elm may be supposed to live 100 years on a very moderate calculation, one tree alone will produce about 15 billions of seeds, so that this tree contains in itself sufficient to multiply and re-produce such a prodigious quantity of plants as would surpass all intelligible numbers,—for we may suppose that each seed or grain in a tree contains in itself a second tree, then consequently there is a geometrical progression of growth, whose first term is one, the 2d 15 billions, the 3d the square of 15 billions, the 4th its cube, and so on *ad infinitum*, so that our reason and imagination would be swallowed up and lost in the immense calculation.

*Means of dispersion.*—For the dissemination of these numerous seeds nature has happily provided in an infinite variety of ways, so that many plants will spread themselves in a short time throughout different and even distant countries. Some of these seeds are provided with wings, and a kind of down, by which they have been known to float in the air for upwards of 50 miles; and, indeed, it is obvious that they must continue to fly so long as the power of the air is sufficient to carry them forward. Some seeds are dispersed by the explosive bursting of the seed vessels; some are furnished with hooks which adhere to the coats of animals till carried to a distance; others of them are picked by birds or devoured by other animals, and are by them deposited uninjured in distant places to which they may afterwards retire. Many species of fruits and seeds are disseminated by man: the squirrel scatters the seeds of the pine by gnawing the cone, as does likewise the loxia when he eats off its bark, almost his only food. Great numbers of plants likewise germinate from nuts and various kinds of seeds that are collected and deposited in the ground by mice and various other animals. Many seeds are likewise dispersed by rivers and by the waves of the ocean, which convey them to a distance from their native place, and transplant them in a foreign land. Other seeds, such as the crupina and bearded oat, travel of their own accord in a very surprising manner, contracting when wet and extending when dry. In some seeds this locomotive power is so remarkable, that those who are not acquainted with their nature are sometimes apt to believe them to be insects. Thus, the seeds of equisetum or fern, when viewed through a microscope on paper, will seem to leap about as if they had feet, by which means they speedily disperse and separate from one another.

*Geographical distribution of plants.*—The study of the relative position and locality of plants, as they are scattered over the surface of the globe, was introduced by Linnaeus, who first conceived the idea of a Flora, from the multiplication and comparison of which all our knowledge in this interesting department of Botany has been derived; many of our Floras are still imperfect, and many countries have not hitherto been regularly explored; yet the genius and sagacity of Brown, De Candolle, and Humboldt, notwithstanding the paucity of materials, have obtained many curious and unexpected results.

Under the name of *stations* of plants have been collected numerous facts, regarding the soils and situations in which they grow. The alisma, for instance, grows in water, the rhododendron on the elevated mossy sides of the Alps, and the lichens on the trunks of trees in the forests, or on the faces of precipices in the mountain ridges. Not fewer than 16 stations have been enumerated and distinguished by De Candolle, who earnestly presses the study of them upon the attention of botanists.

The actual distribution of plants is subject to many modifications, but is chiefly influenced by climate. The general heat and moisture of tropical countries seem to be favourable not only to the developement of individuals but the increase of the species. Thus the species of Phanerogamous plants are most numerous near the equator, and decrease gradually as we approach the poles. Cryptogamous plants, on the other hand, for the most part delighting in cold situations, increase in an opposite direction. Trees follow the general analogy of their classes. In Guiana they compose 1-5th, in France 1-80th, and in Lapland 100th of the whole vegetable kingdom, and as we proceed into the polar circles entirely disappear. This effect of temperature strongly attracts the attention of travellers in ascending mountains. Thus, at the foot of the Andes, the meadows are filled with the rank herbage of the gigantic heliconias, and the dryer grounds with palms. In ascending we come to the plants of extra tropical countries; the turf and trees of temperate climates at length appear, and after passing through the region of brushwood, we at last observe the vegetable as well as the animal world disappear within the varying line of perpetual snow. Among the other effects of climate, we may notice the great abundance of annuals and biennials in temperate countries, and their comparative scarcity in equatorial and polar regions.

The study of the natural orders has afforded several curious generalizations in the geography of plants. Thus the Compositae or Syngenesious class are found in greatest abundance in the temperate zones. In ferns the result is exactly reversed. Some orders, as the leguminosae, increase towards the equator, while others, like the grasses, decrease in the same direction.

There are many facts, however, in the geography of plants, which can be assigned to no general principle. Certain genera are found only in particular places, as hermannia at the Cape of Good Hope, banksia in New Holland, and fuchsia in equatorial America. Other genera are found in great abundance in a narrow district, while a straggling species appears at, perhaps, an opposite end of the earth. All the Mesembryanthemums inhabit the Cape except two, which are found on the shores of the Mediterranean. The genus platanus is composed of two species, one of which grows in the Old and the other in the New world. The three species of Trollius have been discovered in the far distant stations of America, Europe, and Siberia.

*Naturalisation of plants.*—Some exotic plants, which are very prolific and constitutionally hardy, have a natural tendency to accommodate themselves to new climates. Thus the common thorn-apple, which is a native of Abyssinia, may be found growing spontaneously in many countries of Europe. All our grains and vegetables are the products of warm regions, yet, although they do not spring up without cultivation, have been so well naturalized in our northern climates as to grow nearly as vigorously as in their native soil. This is owing, it is supposed, to the continual reproduction from seed which communicates a certain adaptation to the soil and place. Thus, in the island of Guernsey, the Cana Indica has, by repeated sowing, acquired the luxuriance of a common weed. By this means, accordingly, horticulturists are now labouring, and with flattering prospects of success, to impart the requisite hardiness to our more delicate sorts of fruit. It must be remarked, however, that this facility of nature is bounded by certain limits, of which the common potatoe affords a familiar example. Though a denizen of this country for more than two hundred years, it has not acquired a stability of frame sufficient to endure the early frosts of autumn.

*Artificial climate, or method of treating exotic plants.*—To judge rightly of the method of treating plants brought from several parts of the globe, it is necessary to consider the soil of the country they grow in, which should be imitated as nearly as possible, and also the time of the spring, and the degree of heat in the time of the spring, in the country of which they are natives. Every plant has its appointed times of growth and of rest; and to force its growth when nature has ordained its repose, or to abandon it to repose when it should be assisted by a warmth agreeable to its own country, would be altogether unnatural. In the cultivation of foreign plants, it is therefore necessary to consider the latitude of the country and the time of the spring agreeable to every plant. By attending to the latitudes, we cannot fail to give to each plant its force or warmth at its proper season. It may also be proper to remark, that as the sun's great influence is between the tropics, and every year he has, so to speak, his motion from south to north and back again, so this motion will produce two springs every year in each of the countries he passes over; and it may be observed, that when the sun's power is most violent in any place, all plants have finished their spring-shoot, and the greatest share of heat only serves to ripen our fruits. When the spring-shoot is perfected, and the great heat of summer is over, nature begins to make a second shoot; but the sun's heat then declining when our plants want it most, the attempt of vegetation proves vain, and this shoot is seldom to us of any consequence; but it seems obvious, that if these plants had convenient shelter, and additional heat, regulated by the thermometer, so as to make it equal to that of April, there would be no difficulty to bring them to bear fruit in the season of autumn; and some trees have, even without this aid, ripened some few fruit of this second spring, especially if these plants have been deprived of their blossoms in the spring.

PLANTING, in agriculture and gardening, is the art or method of lifting a tree or plant from its natural situation, and setting it in some other place, so as to prevent the growth from being diminished or retarded. See *Hedges*, under the article AGRICULTURE, and *General Remarks* under GARDENING, in this work. Planting, in a more extended sense, and considered as a branch of rural economy, is the most beautiful, and, in the end, perhaps the most profitable of all cultivations. The rearing of forest timber has frequently been considered of so much importance as to be made a national concern.

Planting is designed either for artificial shelter, ornament, or profit, and it is therefore of importance to know the trees best adapted to the various soils, also the proper age and size of the different kinds, and the best manner of planting them.

*Soils.*—Loamy soils, generally speaking, are the best for timber of all kinds, and an irony till, of little depth, on a retentive subsoil, as it upholds a poisonous water, is the worst. The alder thrives best in a spongy soil—the ash arrives at perfection on all soils except a stiff clay with a retentive bottom—the mountain ash, or sarb, arrives at its highest perfection on light sandy and elevated situations, and the beech on deep sandy loams, although on almost any kind of soil it becomes a graceful tree. The birch, the Spanish and horse-chesnut, flourish in many different soils, but most in a deep loam with a dry bottom. The Scotch elm, which is a valuable tree, gives place only to the oak, will suit itself to any soil and any situation, and so will the larch luxuriate, excepting on land of a humid and retentive nature. The lime tree requires a humid loam, also the plane tree (platanus) and all the different species of poplars and willows. In barren and exposed situations the hornbeam is valuable, although inferior to most of the other kinds of timber—the laburnum thrives best in an open soil, so also does the sycamore and walnut—the oak, the most valuable of all timber, arrives at greatest perfection on a deep loam lying on a gravelly or rocky substratum; in most situations it will also luxuriate while young, and even on a tilly clay, but in such soils it is subject to premature and early decay.

Having said thus much as to the deciduous kinds of forest trees, and the soils best adapted to their growth, let us next consider what soils are best fitted for the evergreen or resinous kinds; like those already mentioned, they flourish most exuberantly on deep and sandy loam, or soils that will not retain stagnant water. The cedar of Lebanon will grow on all soils and in all situations, excepting those of a very moist and retentive nature. This tree frequently arrives at a mighty stature, and, independent of its beauty, its timber has the peculiar property of resisting worms, admits of a high polish, and retains a most agreeble smell for ages. The Weymouth pine, the common and the American spruce, and silver fir, all prefer sandy loams, although they will make progress on moist lands, and even in pretty strong clay, if it be supported by an open substratum. The Scotch pine, or Scotch fir, arrives at highest perfection on mountains and bleak situations; on tilly and retentive clays it becomes stinted in twenty or thirty years, nor ought it to be planted in rich and sheltered situations, unless for nursing other trees, as its timber there is much inferior in quality to that which is produced on the mountains.

*In procuring the plants*, it is universally acknowledged, that it is by no means profitable to raise them from the seed, although a vast saving is to be obtained in nursing seedlings. As to the age and size of the plants, much must necessarily depend on the soil and situation for which they are intended. When the plants are too large, unnecessary expense is thereby incurred, and it is quite certain that, in most situations, young plants will outgrow the old in the space of seven years.

*As to the distance* at which the trees should be planted, this also must in a great measure depend on the soil and situation, together with the breadth and extent of the plantation. If the situation be much exposed, and the soil poor, the plants will require to be no more than two feet distant, which is allowing about eleven thousand to the Scotch acre; but in more sheltered grounds and better soil, three feet distant will be sufficient (or between six and seven thousand per acre) and in land of the best quality four or five feet apart will be a proper medium; in belts or clumps of an hundred feet diameter on thin soil, the margin on all sides should be planted at not more than two feet distant; in narrow stripes also, the plants should be thicker throughout than in a more extended plantation, and in all cases where the plants are large they ought to be thicker than when they are of little size, because three of the large plants commonly fail for one of the smaller; promiscuous irregular planting is generally preferred, except when it is intended to crop for some years with vegetables in the plantation.

In regard to the *mixture of trees*, this will greatly depend on the fancy of the planter. When the soil is good, and it is intended to give the preference to the oak, it has been recommended to plant two oaks for one elm, two elms for one beech, two beeches for one ash, two ashes for one birch, and two birches for one sycamore. Some proprietors plant in groupes, and, in this case, the trees are kept in distinct classes. In deep loamy earth they plant the oak, the elm, the ash, the chesnut, and walnut—on sandy and gravelly soils, they plant the mountain ash, the beech, the larch, the sycamore, and hornbeam—on poorer and mixt soils, they plant the pine tribes—on moist grounds, they class together the aquatics, such as the alder, poplar and willow, and the sub-aquatics, such as the birch, the lime, and the American plane. As nurses in the forest, the larch is now preferred to the native pine, as it surpasses it in growth in every situation.

In some situations copse-wood is more profitable than timber of any kind, on account of the value of the bark chiefly; in this case, oaks are planted at nine feet distant, and are nursed by larch and common fir till sixteen or twenty years of age, when the whole is cut over, and in a few years there arises a beautiful and a profitable copse-wood.

With respect to the *proper season* of planting, the most eligible is the beginning of November to the end of March; but this may vary a little, according as the season is wet or dry, early or late. By spring planting, trees lose a year, or are killed if a dry May succeeds, which is often the case. Indeed, from the 20th July to the end of August is reckoned the best season for planting many of the resinous tribes, such as the cedar, Weymouth pine, the Scotch and silver firs, and the spruce, if the weather at any time be cloudy and wet; but they will also succeed if planted towards the end of April, should the season prove moist.

Respecting the *method of planting*, some prepare the ground by the plough and harrow, and others by the spade. Pitting trees is now generally exploded, but may nevertheless be practised successfully when the pits are properly prepared. In all cases in which this method is practised, the pits should be opened to a proper depth six months previous to planting, and the turf being then rotten is shaped in the bottom of the pit, and the finest mould is carefully placed on the fibres of the plant, and pressed down with the feet. But the most common mode of planting is by slit, or the letter T, and the method is to strike the spade at random to the depth of the turf, and then strike it crossways at the end of this incision, and at right angles with it; a boy then places the root of the plant on the plate of the spade, and draws it gently into the opening, and when the spade is drawn out he treads the turf closely down. A man and boy, in this manner, are supposed to plant fifteen hundred trees in ten hours. Care must be taken not to plant too deep, as this destroys the tree, for when the live bark is buried in the earth, cancer takes place, and the tree dies.

It is also of importance, to attend to the size and age of the plants. From experience, it has been ascertained, that, except in very sheltered situations and rich soils, trees three or at most four years from the seed, and from one to two feet high, will outgrow those of any size of the same species under eight or ten feet within the seventh year, with the exception, perhaps, of the poplar and the lime.

Trees in general ought not to be nursed more than two seasons, having been previously one or two years in the seminary, according to their kinds. The birch and alder should be two years in the seminary; but if the plants be particularly stout and healthy, they may at one year old be removed into nursery rows, and next season will be fit for planting. A one year seedling larch, nursed one or two at most, will outgrow all others of its species in any situation, and firs of any kind will succeed best if from fifteen to twenty-four inches high. The spruce and Scotch firs, if the plants be stout, may be planted from the seedling-bed, whereas all top-rooted plants require a year at least of nursing in a kindly soil. Two year seedling sycamore, ash, mountain-ash, elm, birch, and hornbeam, nursed one season, are of an age most proper for planting—but two years seedling-oak, beech, chesnut, and horse-chesnut, whose roots have been topped, and which have been two years nursed, are to be preferred. If the soil, however, be of great depth, and if the desire of immediate appearance and shew prevail, then plants of all kinds may be nursed still a season longer.

In all cases where planting becomes an object, the ground ought to to be well cleared, completely drained, and effectually secured against the encroachments of cattle, as without these it is vain to look for success. In the course of a few years, thinning is also essentially necessary for the attainment of valuable timber, and, where this is properly performed, it has been found that a tree will double its size every six years; so that the value of the timber, as well as the beauty of the trees, is infinitely improved by this attention, and the thinnings will, in general, be sufficient in the course of a few years to pay all the expense.

Some prefer sowing oaks rather than planting them, as this tree is slower of growth when planted than sown, especially for the few first years after planting. But by heading down planted oaks, they come little short of sown ones. Indeed many of the deciduous tribes are improved by heading down, if they have at any time symptoms of being stunted. When oaks are sown, it is generally the second or third year after the field has been planted, the other trees being intended as a shelter to the sown ones. April is the season for sowing, and three nuts or acorns are sown in a patch, and the patches are from 24 to 30 feet distant—the turf is pared off, and the soil stirred to its full depth about a foot diameter, in which three acorns are deposited about three inches deep and six apart; the patches will require clearing at midsummer, and again in May following, then the best plant is singled out in next March, and the others carried to the nursery.

Planting, independent of its being of national importance, will ultimately be profitable to the proprietor, especially on ground of inferior quality, as no crops can be cultivated which, in the end, will pay so handsomely for the trouble and expense.

*Pruning.*—The necessity and advantages of forest pruning must be obvious to every one whose attention is directed to the first stage and progress of a tree towards its maturity and becoming timber, which, as almost every one knows, is valuable for at best a very few purposes, in proportion to the *straightness of its grain or freedom from knots.* Young trees of most kinds, as soon as of the size of a common quill, are furnished with lateral branches, which originate at the very pith of the stem; and in considering how very essential these are for some years to the growth and existence of the plant, the principle whence a clear trunk, without knots or branches is to spring, can readily be perceived; and it must be obvious that if each of these laterals continued ever after as essential to the health and existence of the plant as they were at their first production, that knotless trees or timber would be altogether unattainable. Experience teaches, that the greater part of them are only of temporary importance to the tree. In a natural state, when neither men nor animals assist in removing these useless laterals on the lower parts of the trunks of trees, they decline in vigour, owing in a great measure to the shade either of the higher branches of the tree itself, or the branches of those that surround them, and in process of time they rot and often fall off by their own weight. These being the facts, it becomes the province of man to assist the operations of nature. On the benefits arising from judicious pruning, Sir Joseph Banks, in his answer to the thirty-eighth of Lord Glenbervie's queries, asserts, that tall and straight oak-timber will produce to the grower ten times as much money in a given time as crooked timber, though applicable to the knees of ships; and the more especially this must now be the case, as this kind of timber is rendered less necessary in consequence of Hookey's improved method of bending timber for building large ships. An excellent drawing and description of his machine will be found in the *Mechanic*, or Compendium of Practical Inventions, by James Smith, author of the Panorama of Science and Art. The inventor of this machinery bent the largest piece of timber ever bent in England, to a four feet eight inch curve in 33 feet long, for a floor timber for the Black Prince of 74 guns, in eight minutes, which many persons thought to be impossible, and which, in one floor-timber alone, was a saving of L.12.

Mr Pontney shews, that 40 feet distances are necessary, or only about 27 large oaks to the acre. for trees unpruned, owing to the flat-spreading and close form of their heads, but that the properly trained open, high, and conical heads of such trees will admit of their standing at 25 feet distance, or about 70 trees to the acre, and of the most profitable kind. This, then, must be a strong inducement to pruning and management. Trees of the deciduous kind long neglected, it may be observed, can never be rectified, and the only fit remedy for these is that of the feller, to make room for others to be reared under more favourable circumstances. With the fir tribe it is somewhat different, as their arms seldom bear any proportion to the size of the trunk, and their knots not being so liable to decay as those of all deciduous trees, and their not being so able to sheel again from the trunk; and with them it is never too late to begin very close pruning, conducted with moderation, so as never to diminish the live twigs and foliage of the tree by pruning off more than one-fourth part of them at the most in any one season; but all dead branches ought instantly to be removed, and even pruned firs will pay amply for the trouble, however they may have been previously neglected. Mr Pontney has ascertained, that when trees produce numerous luxurious side-shoots after being headed and lopped, they make no perceptible increase in the size of their trunks. As to the alleged bleeding or running of sap from the wounds of fir after moderate pruning, it is rather beneficial than otherwise, since the resinous part of the sap dries on the wound, and excludes the air and wet, which is the best preparation that could be for the new bark to close upon. The President of the Royal society, in reply to the fourth query of Lord Glenbervie respecting timber, says, that " all forest trees should be pruned annually, till they have attained considerable growth. The branches should be cut off close to the stem, and quite smooth; and he has no doubt that the cost of annual pruning, if judiciously done, will be repaid with ten-fold interest."

PLANTATION, a spot of ground in the colonies assigned to a person for the purpose of cultivation and the formation of a new establishment. The term is sometimes applied to a colony.

PLASHING of quickset-hedges, for promoting the growth and continuance of old hedges. See AGRICULTURE.

PLATA, RIO DE LA, or River of Silver, a great river of South America, which was so called by Sebastian Cabot from his having taken a considerable booty in gold and silver from a body of Indians whom he defeated on its banks. See BUENOS AYRES.

PLATED-MANUFACTURE, the art of covering copper and other metals with a thin coating of silver, is divided into three branches, to each of which a distinct set of workmen is allotted. 1. Braziers, employed in making vessels that require to be raised by the hammer. 2. Candlestick-makers, who manufacture all the varieties of these articles. 3. Peirce-workers, who fabricate all those articles made of wire. The metal to be plated is generally a mixture of copper and brass, formed with great care into ingots, the faces of which are thus smoothed for receiving the silver. After this, the silver, also well polished, is laid upon the smooth side of the inferior metal, to which it is bound with wire. Then a saturated solution of borax is insinuated under the edge of the silver plate on each side, and this fusing at a low heat prevents the oxygen of the atmosphere from affecting the surface of the copper, so as to prevent the adherence of the silver. The ingot, thus prepared, is now heated in a furnace constructed for the purpose, till the two metals are inseparably united; and afterwards rolled between cast-iron rollers to the thinness required; it is also annealed from time to time, immersed in a hot dilute of sulphuric acid, and then scoured with fine Calais sand.

Plates formed in this manner are given to the braziers to be wrought by them with the hammer and the die into vessels of a great variety of shapes, sizes, and uses. The feet of candlesticks is formed with the die, as well as other parts of them. In forming bread-baskets, toast-racks, and other articles made of wire, the proper bend is given with a wooden mallet Plated goods are burnished with blood-stone.

PLATO, a celebrated Athenian philosopher, was born in Ægina, about 430 years before the Christian era; and, by his father, he could trace his descent from Codrus the last king of Athens, and, by his mother, from Solon the legislator. He gave early indications of original genius, and received an excellent education. At first, he applied himself to painting and poetry; but having heard Socrates deliver a discourse, he burnt his poems, renounced the muses, and devoted himself to the study of philosophy, continuing the pupil of Socrates during the space of eight years. He wrote the substance of his master's discourses in the form of dialogues, but added to them many opinions of his own, insomuch, that when Socrates heard him recite his Lysis, he cried out, " O Hercules! how many things does this young man feign of me." He, however, continued warmly attached to his master, and exerted himself to save him from an ignominious death. After the death of Socrates, Plato went to Megara, where he was entertained by Euclid. Thence he went to Italy, where he studied the doctrine of Pythagoras; afterwards he visited Cyrene, Egypt, and Persia, acquiring a knowledge, in each of these places respectively, of geometry and theology. On his return he went again into Italy, that he might farther improve himself under Timæus and others; was taught the Pythagorian doctrines at Tarentum; and now, with a mind richly imbued with every kind of knowledge, he settled in Athens, and began to teach philosophy. He chose, for this end, a public grove, bequeathed to the citizens by Hecademus, and hence called the Academy.

This school soon became celebrated, and was attended by the most eminent men of the age. This deserved success drew upon him the hatred of the envious, and exposed him to detraction, censure, and obloquy; and his abstract speculations were ridiculed by Diogenes the Cynic. He was never married, and, on his death in the 81st year of his age, his friend Adiamantus became his heir; the grove in which he had long taught afforded him a grave, while his writings form for him an imperishable monument to his memory. His character is that of a great philosopher and an excellent man. Cicero admired him greatly, and called him the *Homer of Philosophers.*

PLATONIC PHILOSOPHY, the system of doctrines taught by Plato and his followers; combines the physics of Heraclitus, the ethics of Socrates, and the metaphysics of Pythagoras, together with some opinions peculiar to the Academy. The original cause of all things Plato called the universal essence, and held that the world was an intelligent being, consisting of a body and a soul, which he denominated the *generated God.* His *Demiurgus*, the framer of the world, was a being derived from and inferior to the supreme God—the Universal essence; and he maintained, that there were vast numbers of these derivative spirits, both supramundane and mundane. Among these were the sun, the moon, the stars, and the earth. Matter, in a chaotic state, he said, was eternal, and that the production of the universe was partly necessary and partly designed. To matter, which he regarded as essentially evil, he attributed the origin of all the physical and moral evil which exists. Fire, air, earth, and water, according to him, were the principles of all things. He said there were two heavens,—the empyrean, of a fiery nature, and the abode of angels; and the starry heavens, not hard and solid, but soft and yielding. The human soul, he held, was an emanation from the universal essence, and hence had existed from eternity, and was immortal; being thus of divine origin it was not affected by the diseases of the body, but flourished in immortal youth amid the decay of nature and the crash of worlds. From this doctrine of the soul resulted that of the transmigration of souls—or the passing of the soul from one body, on its death, immediately to animate another, and this through an endless succession of generations. From the proneness of man to evil, Plato concluded that the soul was in a lapsed state; but was of opinion, that, by a proper direction of his powers, he might rise to the immaculate purity of his first estate. He thought there might exist in the world a community of persons whose passions were uniformly under the control of reason, who, having a foresight of the consequences of inordinate indulgence, aspired, by moderate desires and good practice, to excellence, and arrived at perfection. From this view of the capacity of man to extricate himself from moral defilement, he was led to compose his Republic, which he intended at once to illustrate his doctrines and to afford a model of the conduct which he had abstractly represented. Plato regarded mathematics as so essential to the knowledge and application of his system, that he admitted none ignorant of geometry among the number of his disciples. The most celebrated of these were Xenocrates, Aristotle, Lycurgus, Demosthenes, and Isocrates. Aristotle taught the doctrines of his master in the Lyceum; and to distinguish his disciples from those of Xenocrates who succeeded Plato in the Academy, they were called Peripatetics.

The Platonic philosophy has been more or less cultivated in every age downward from the time of its celebrated author. About the year 230 of the Christian era, the name of Academics was abandoned and that of Platonists adopted in its place. This is said to have been first done in Alexandria by Ammonius Saccas, a Christian philosopher of that city. He and his associates in some degree remodelled the doctrines of Plato, and corrupted the simplicity of the Gospel by mixing them with it. From Alexandria they revived, and as it was thought, the reformed philosophy of Plato was brought to Rome and taught there by Plutarch. Theophilus Gale, in his Court of the Gentiles, printed in 1677, as well as many other authors, has endeavoured to prove that Plato derived much of his philosophy from the Holy Scriptures, which he might meet with in Egypt.

PLAUTUS, M. Accius, a comic writer of ancient Rome, who acquired the surname of Plautus, from having splay feet. He was born at Sarsina, in Umbria, and died in the year 184 before Christ. Aulus Gellius says, from Varro, that Plautus was so well paid for his plays as to double his stock in trading. In his commercial enterprises, however, he was so unfortunate that he was reduced to the greatest poverty, and was obliged to enter into the service of a baker, who employed him in grinding his corn. There are twenty of his comedies extant, though some of them are in a very mutilated condition. Five of them were translated into English by Mr R. Thornton, and published in 1767. The best edition of the plays of Plautus are those of Gronovius, 8vo, Lugd. Bat. 1664; of Barbou, 12mo, 3 vols. Paris, 1759; Ernesti, 2 vols. 8vo, Leips. 1760; and that of Glasgow, 3 vols. 12mo, 1763.

PLAYFAIR, John, an eminent mathematician and natural philosopher, was the son of a clergyman, and was born at Benvie, in Forfarshire, in 1748. At the age of fourteen, he entered the university of St Andrews, where he so much distinguished himself by his progress in natural philosophy that Professor Wilkie selected him to instruct his class during his indisposition.

Upon the death of Mr Stewart, professor of mathematics in Marischal college, Aberdeen, Mr Playfair was one of seven candidates for the vacant chair; on which occasion he was excelled only by two out of six, viz. Dr Trail and Dr Hamilton, the former of whom is said to have attributed his own success to the disparity of years between him and Mr Playfair. When, in 1772, the chair of natural philosophy became vacant, by the death of Dr Wilkie, he made another effort to obtain a public literary appointment, but was unsuccessful. In the same year, the death of his father devolved upon him the protection and support of his mother and her family; and this circumstance appears to have determined him to follow the clerical profession, to which he had been educated; and through the favour of Lord Gray, he, in 1773, obtained the living of Liff and Benvie, which had been possessed by his father. About four years afterwards, Mr Playfair communicated to the Royal society of London an essay *On the Arithmetic of Impossible Quantities,* which was published in the Transactions, and was the first display of his mathematical attainments. In 1782, he resigned his living, in consequence of an advantageous offer held out by Robert Ferguson, Esq. of Raith, to superintend the education of his two eldest sons; and three years afterwards, when Dr Adam Ferguson exchanged the chair of moral philosophy for that of mathematics, which was then filled by Mr Dugald Stewart, he was appointed joint professor of mathematics, a situation for which he was peculiarly well adapted.

Mr Playfair was one of the original fellows of the Royal society, and contributed, in an essential manner, to promote the interests and to add to the renown of this learned body. He succeeded Dr Gregory in 1789, as secretary to the physical class of the Royal society; and the management of the society, and the arrangement of its Memoirs for publication, devolved chiefly upon him, when Dr Robison, the general secretary, became unable, from indisposition, to fulfil the duties of his office.

In 1795, Mr Playfair published his Elements of Geometry, which has been held in high estimation as an elementary work. After the death of Dr James Hutton, in 1797, Mr Playfair became zealously attached to geological pursuits. In the year 1802 he produced his *Illustrations of the Huttonian Theory,* in one vol. 8vo; and on the 10th of January 1803, he read to the Royal society of Edinburgh his *Biographical Account of the late Dr James Hutton.* These two works we cannot but regard as the productions by which the name of their author must be handed down to posterity.

In consequence of the death of Dr Robison in 1805, Mr Playfair was made general secretary to the Royal society; and he was also happy in being appointed to the vacant chair of natural philosophy. In the same year he laid before the Royal society *A Biographical Account of the late John Robison, LL.D.* In 1815 he undertook a journey to the continent, for the purpose of prosecuting his geological investigations; and, after spending about 17 months in France, Switzerland, and Italy, he returned to Edinburgh in 1816, eager to complete his great work, the *Illustrations,* which, however, he did not live to accomplish. He died in 1819, in the 72d year of his age. The different public bodies with which he was connected testified their respect for his worth and talents, by following his remains to the grave.

Besides the works which bear Mr Playfair's name, he wrote different articles in the *Edinburgh Review,* some of which have been reprinted among his works, and are very characteristic of his powers as a natural philosopher, a profound mathematician, and a cultivator of the lighter branches of literature.

The reader will find an ample account of the life and writings of Mr Playfair in an edition of his works published by his nephew Dr Playfair, in 3 vols. 8vo.

PLEA, what a party at law urges in behalf of his suit, is carried on either in the king's name, for the punishment of crimes against his person, government, or people, or in the name of one subject against another for the maintenance of their reputation, property, and other rights. Pleas carried on in the king's name are termed crown pleas; and those of subject against subject, common pleas. Common pleas are again divided into two kinds,—dilatory pleas, and pleas to the action. The former, as the name imports, seek delay by questioning the authority of the court to decide the question at issue, and the inability of the plaintiff to commence and carry on a suit, from his being an alien, an enemy, attainted of treason, &c. or by seeking an abatement in consequence of some defect in the writ, as a misnomer. When these dilatory pleas are allowed, the cause is dismissed, or removed to another court, or stayed till the disability is removed, or carried on under a new writ in an amended form.

*Pleas to the action,* again, are made by confessing or denying the complaint; and the conditions of both are, that the plea be simple, referring to one matter only,—that it be direct and positive, not argumentative,—that it be distinct as to time, place, and persons,—and that the plea be such as to be capable of trial. In special pleas, some new fact is always advanced, not mentioned in the declaration,—something which the pleader is ready to verify.

PLICA POLONICA, or *Trichoma,* a disease of the hair, peculiar to Poland and the neighbouring countries, in which, from the disposition of morbid matter, the hair becomes matted together so as to form masses which cannot be unravelled. The commencement of this disease is attended with clammy sweats and a sensation of lightness about the head; a greasiness collects on the hairs, and their smell becomes disagreeable; and from the quantity of morbid matter deposited on them, they sometimes burst. See the Manchester Memoirs, Vol. IV. Part 2.

PLINY, THE ELDER, CAIUS PLINIUS, SECUNDUS, one of the most learned of the ancient Roman writers, was born at Verona, in the reign of Tiberius, A. D. 23. He distinguished himself early in the field; was one of the college of augurs; became intendant of Spain; and was employed in several important affairs by Vespasian and Titus, whose esteem he had the happiness to enjoy. To his public duties he was by no means inattentive, yet he devoted all the leisure time that he could command to literary and scientific pursuits. Such indeed were his habits of industry, that at his meals, and while he was dressing, he used to have one of his servants reading to him. In a memorandum-book, which he kept for the purpose, he constantly inserted notices of all the information which he acquired. A vacant hour never occurred which he did not employ in reading and writing; and he went from place to place in a sedan, that he might occupy himself with reading on the road. This great man being too curious in observing the effects of a violent eruption of mount Vesuvius, and staying too long near it in the house of his friend Pomponius, he was suffocated by the sulphureous flames. Three days after, his body was found and decently interred by his nephew, who happened to be then at Misneum with the fleet. His nephew, Pliny the Younger, relates the circumstances of that dreadful eruption, and the death of his uncle, in a letter to Tacitus. The *Natural History* of Pliny the Elder is regarded as one of the most valuable remains of antiquity; it consists of thirty-seven books. He is said to have written 160 volumes of annotations on the different authors which he read; and one Lartius Lutinus is said to have offered a sum equal to L.3242 Sterling for these notes. The best editions of Pliny are, that of Hardonius, 3 vols, folio, Paris, 1723; that of Frantzius, 10 vols, 8vo, Lips. 1778; of Brotier, 6 vols, 12mo, Paris, 1779; and the Variorum edition, 8vo, in 8 vols, Lips. 1778.

PLINY THE YOUNGER, CAIUS PLINIUS CAECILIUS, SECUNDUS, was the son of L. Caecilius, by a sister of Pliny the natural historian, and was born A. D. 62, at Novocomum, a town upon the lake Larius, remarkable for nothing so much as for being the place of nativity to so great a man. His uncle, at his death, left him heir of his name and estates. He was educated under that master of eloquence Quintilian, and at the age of 19 he distinguished himself at the bar to such a degree that he and Tacitus were considered the greatest orators of the age. During the perilous reign of Domitian, he continued to plead in the forum with such boldness and propriety that he was frequently made choice of by the senate to defend the plundered provinces against their oppressive governors, and to manage other important causes. He also filled the offices of questor, tribune of the people, and prætor; and fortunately escaped the tyranny of Domitian, though it appears his name was afterwards found in that emperor's tablets in the list of those who were devoted to destruction. He was appointed by Nerva to the post of president of the Saturnian treasury; and in the third consulate of Trajan, he was named one of the honorary consuls, on which occasion he delivered his much admired panegyric on that emperor. He afterwards obtained the augurate, and was then made proconsul of Bithynia; whence he wrote his famous letter to Trajan, respecting the primitive Christians, which, with Trajan's receipt, is still extant among his epistles. What became of Pliny after his return from Bithynia, is not known, but it is conjectured that he died about the year A. D. 113.

Pliny wrote many works, among which was a History of his own Time, but all of them that remain are his Epistles in ten books, and his Panegyric upon Trajan. In his Letters, which are written with great spirit, and seem to have been intended for the public, are preserved anecdotes of many distinguished persons whose works have come down to us; as Suetonius, Silius, Italicus, Martial, Tacitus, and Quintilian. The best editions of the works of Pliny the Younger are, that of Gesner, 8vo, Lips. 1770, and of Lallemand, 12mo, Paris. The Variorum edition of the Epistles by Veenhusius, Lugd. Bat. 1667, is excellent; and also Swartz's edition of the Panegyric, 4to, 1746. Mr Melmoth's translation of the Epistles of Pliny into English has been much admired.

PLUMBAGO, a species of coal, known also by the names of graphite and black-lead, is found in the mines near Keswick and Berrodale in Cumberland, and lately in the vicinity of Ayr in Scotland, and forms a valuable article of commerce. It occurs in beds of various extent and thickness, and the finest specimens are boiled in oil and formed into black lead pencils, while the inferior sort is used to blacken fenders, stoves, and grates. Crucibles for certain processes in chemistry are also made of it; and it is an ingredient in the paste used for making razor-straps, and in that for luting chemical vessels. Plumbago is composed of carbon and oxygen, with occasionally a small portion of iron. This substance is sometimes found formed in cannon, the iron cones of porter-backs, and other articles made of cast-iron, and this kind becomes hot on exposure to the atmosphere, because it then absorbs oxygen. The guns belonging to the Spanish Armada, recovered in 1741, at the sound of Mull, Argyleshire, by means of diving-bells, were found greatly corroded, and, when scraped, they became hot, to the astonishment of the Highlanders. Black-lead may thus be made artificially.

PLUTARCH, a distinguished philosopher and biographer, was a native of Chaeronea in Bœotia, but neither the time of his birth nor the incidents of his life are well known. He received a good education under Ammonius, an Egyptian, and afterwards travelled to Egypt, then famous for learning. On his return he visited all the academies and schools of the most eminent philosophers, but does not seem to have attached himself to any as a devoted partizan; though it is known that he disliked the paradoxes of the Stoics, and detested the impiety of the Epicureans. Socrates, Aristotle, and Plato were his chief favourites, whose doctrines he studied, and whose memory he revered. He visited Sparta, to obtain materials for the lives of its great men; and with the same design he passed some time at Rome, where it is said he was the preceptor of the emperor Trajan. He is accused of ignorance of Roman antiquities, and of partiality to the Greeks; but by most he is regarded as a man of good sense, candour, and kindness of heart, whose works both moral and biographical are valuable for instruction.

PLUVIAMETER. See *Rain-Gage* under METEOROLOGY.

PLYMOUTH, an important sea-port town of England, in Devonshire, situated on a tongue of land between the rivers Plym and Tamar, at their confluence with the sea, by which a safe and capacious haven is formed.

*Town and suburbs.*—Plymouth, occupying the eastern side of the neck of land on the Plym, the Dock, or Davenport as it is now called, or the western side of the Tamar, and Stonehouse, the intermediate space, form almost a continuous range of buildings across the whole of its breadth. Plymouth is rather meanly built; the streets being narrow, irregular, steep, and dirty; but it contains some public edifices worthy of notice. The most ancient of these is the parish church, consisting of nave, side aisles, and chancels, with a tower at the west end ornamented

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with pinnacles. There is another church in the town consecrated to the memory of Charles I. The hotel, theatre, and assembly-rooms, with their appendages, cover nearly an acre of ground, and reflect honour on their architect. The Athenæum, public library, and custom-house, as well as the exchange, the market-place, the workhouse, and some of the dissenting chapels, are convenient and tasteful structures. The town supports many charitable institutions, and carries on an active trade with Newfoundland, besides the importation of coals, corn, wine, timber, and other articles for the consumption of the town and adjacent country. Some spirited merchants have embarked in the South sea whale fishery, and steam-boats have been established in aid of the coast trade. Plymouth-dock, or Davenport, rises gently from the shore of the harbour, commanding, as it ascends to the higher grounds, varied and picturesque views. The streets have been laid out on a regular plan; the houses are well built, and the pavement being of marble, with which the neighbourhood abounds, exhibits a beautiful appearance after rain. The town is almost surrounded by fortifications, and most of the public buildings are connected with government; among which are the houses of the governor and the port-admiral, a cordon of barracks capable of containing 3000 troops, the gun-wharf, and the dock-yard. The dock-yard, though still unfinished, is regarded as one of the finest in the world. The wall, which separates it from the town, is, in some places, 30 feet high, and incloses an area of more than 70 acres in extent. The docks are numerous, and on a magnificent scale; and the various contrivances for forwarding the object on account of which they have been constructed, and the scenes of activity and power which they exhibit, are altogether astonishing

Stonehouse, formerly Hipeston, lies between these two places, on the road to the ferry at Newpassage, and contains the royal navy hospital, and near it are the royal marine barracks, forming an oblong square, and built to accommodate a thousand men. In the neighbourhood are several other towns, and some noble seats. Plymouth and its suburbs contain a population of 61,212 individuals, nearly one half of whom reside at the Dock.

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*Harbour.*—The port consists of several excellent havens, namely, Catwater, Sutton-pool, Stonehouse-pool, and Hamoaze. Sutton-pool is near the town, and encircled by its buildings; and all ships which enter it are subjected to certain dues. Catwater is capable of protecting 500 ships from the south wind, and has several villages on its banks. The Sound is well fitted for a naval rendezvous, but it is exposed to the southern gales; but, to obviate this disadvantage, a stupendous breakwater has been constructed, or rather is constructing, for it is not yet completed. The expence of this work is estimated at L.1,171,100 Sterling. Fourteen miles from the pier is the Eddystone lighthouse, the base of which has long braved the heavy billows from the Atlantic and the bay of Biscay; and in the midst of the harbour is the small island of St Nicholas, covered with fortifications, which command the entrance into the Hamoaze and the Catwater.

*History.*—In the time of Henry II. Plymouth was a small fishing town; but having gradually increased in size and importance, it obtained from Henry VI. the privilege of having a mayor. Sir Francis Drake, who was a native of this place, obtained many advantages for it from Queen Elizabeth; and this gallant admiral, at his own expence, conveyed water to the town from springs in Dartmoor, in a winding channel of 24 miles in length. The spot is still shewn where Sir Francis was playing at bowls when the Spanish armada hove in sight.

# PNEUMATICS.

Derivation.

PNEUMATICS, from a Greek word which signifies *spirit* or *air*, is that department of natural philosophy which treats of the mechanical nature and properties of elastic fluids, such as air, steam, and vapour, both at rest and in motion, and explains the construction and uses of various mechanical contrivances depending upon those properties.

Under the limits usually assigned to Pneumatics in a work of this kind, it is less extensive than most other departments of mechanical philosophy, as it relates chiefly to the gravity, pressure, expansibility, and dilatibility of elastic fluids; their effects on bodies floating or immersed in them, their momentum when in motion; and the various instruments, as bellows, pumps, fire-engines, air-pumps, air-guns, steam-engines, and steam-vessels, which have been contrived, on pneumatical principles, for the purposes of utility or amusement. But, in a more enlarged sense, the science is very extensive, and comprehends the consideration of the phenomena of sound, usually treated of under ACOUSTICS, the principles of MUSIC, and the principles and practice of navigating balloons through the atmosphere,—see AEROSTATION.

Definition.

The utility of this science will appear from its relations to other departments of knowledge. It assists *physiology* in explaining the sense of hearing, the mechanism of respiration, and the flight of birds. It is of the utmost importance in *meteorology*, as furnishing those facts and principles which depend on the mechanical properties of air and vapour. It is less indebted to *mathematics* than most other departments of physical science; but it is intimately connected with *mechanics*, both by the nature of the objects which it embraces and the contrivances it has suggested. It is related to *optics*, so far as it helps to explain the appearances produced by the refractive power of the atmosphere,—and to *astronomy*, as it accounts for several anomalies in the appearances of the heavenly bodies. Its relation to *chemistry* is obvious, both from the nature of the substances on which it treats, and the necessity of learning their mechanical properties, before their combinations, decomposition, and effects as chemical agents, can be properly understood. It is of great utility in many of the arts, as it explains the action of several instruments, especially the steam-engine, now generally employed to diminish manual labour.

The science has been divided into two parts, *aerostatics*, which treats of elastic fluids in a state of rest, and *pneumatics*, which treats of their effects when in motion, and of pneumatical instruments; but such a division is unnecessary, and will not be adopted in this treatise.

*History.*—The ancients appear to have paid little attention to pneumatics as a science. They considered air as one of the four elements, or simple substances, of which they believed all natural bodies to be composed. But the origin of pneumatics as a science can scarcely be traced farther back than the beginning of the 17th century, when Gallileo demonstrated that air has weight, and that the rise of water in pumps is owing to that property. He was followed by his pupil Torricelli, who, by his experiments, on what has from him been called the Torricellian tube, not only established the doctrine of his predecessor, but led to the invention of that useful instrument the barometer. The completion and adaptation of this instrument are due to Pascal, who, in the middle of the 17th century, not only shewed how it might be employed to indicate the pressure of the air under various circumstances, but suggested its use in measuring heights which cannot be easily taken by the ordinary means.

The elasticity of the air was satisfactorily proved by Newton about the end of the 17th century; but the law according to which that elasticity is increased or diminished was established by Boyle, who also nearly determined the specific gravity of the air. To Boyle also we are indebted for the invention of the air-pump, and the contrivance of several pneumatical experiments. Boyle's air-pump was unwieldy and imperfect; but it was rendered more convenient in size, and more perfect in its operation, by the celebrated engineer Smeaton, and has since been still farther improved by Cuthbertson.

The law according to which the density of the atmosphere decreases at different distances above the earth's surface, was ascertained by Cotes early in the 18th century. During that century, too, the method of measuring heights by the barometer was greatly improved by M. de Luc and Bishop Horsley; but it is only in the present age that it has been brought nearly to perfection by the labours of Sir George Shuckburgh, General Roy, and Mr Dalton. This last philosopher has also successfully investigated the nature and properties of vapour.

The application of steam, as a moving power, was suggested by three different writers, at three different periods of the 17th century; Brancas in Italy, 1629, the Marquis of Worcester in 1663, and M. Papin, in France, 1690, and it is difficult to determine, whether either of the two latter were acquainted with the suggestions of the former. These suggestions prepared the way for the invention of the steam-engine, one of the noblest exertions of human genius. The first instrument of this kind appears to have been constructed by Captain Savary, at the close of the 17th century; and in the early part of the 18th century the machine was greatly improved by Newcomen and Crawley. For many years the steam-engine, on Newcomen's construction, was repeatedly erected at the entrance of mines, and in extensive manufactories, till it received its celebrated improvements from the late Mr Watt of Birmingham about 1765.

It was reserved for the 19th century to witness the completion of the most extraordinary application of the steam-engine that ever entered the mind of man,—the navigation of vessels. This invention has been very generally ascribed to the Americans; it has been satisfactorily proved that the honour of suggesting it, if not of carrying it into practice, is due to an Englishman, Jonathan Hulls of London, who, in 1723, obtained a patent for the contrivance, and in 1737 published a small pamphlet, in which it is clearly explained. It also appears that, before 1787, Mr Miller of Dalswinton, in Scotland, had directed his attention to the same subject, and in that year he carried his designs into execution on the Forth and Clyde canal. It appears that, about the same time, Mr John Finch of Philadelphia conceived a similar idea; so that, though the Americans are not entitled to the merit of the first discovery, they still deserve the honour of original invention. The engineer employed by Mr Millar was Mr Symington of Edinburgh, who afterwards improved on the original plan, and in 1802 constructed a steam tug-boat, for drawing vessels through the Forth and Clyde canal. In 1806, or 1807, the first American steam-boat, constructed by Mr Fulton, an engineer who had witnessed the successful performance of Mr Symington's steam-boat in 1802, was launched on Hudson river, and since that time the contrivance has been carried to great perfection both in America and Britain. In the latter country, indeed, steam boats were not generally employed before 1812. There are now about 160 of various sizes employed in the rivers and along the coast of Britain, and some of them are above 500 tons burden. Steam-vessels have even crossed the Atlantic between America and Britain in about half the time usually employed in sailing; but whether the daring project, now in agitation, of venturing an East India voyage in such a conveyance, shall be crowned with success, time only can determine.

The principal works treating of Pneumatics are, Boyle's Treatises on Air in his works; Cotes's *Hydrostatical and Pneumatical Lectures*; Enfield's *Institutes of Natural Philosophy*; Nicholson's *Introduction to Natural Philosophy*, Vol. II.; Cavallo's *Elements of Natural or Experimental Philosophy*, Vol. II.; and Young's *Lectures on Natural Philosophy*, Vol. II.

## Chap. I. Principles of Pneumatics.

This chapter includes the consideration of the nature and mechanical properties of elastic fluids, the phenomena depending on their equilibrium, and the effects which they produce on bodies immersed in them, or subjected to them while in motion.

### SECT. I.—*Of the Nature and Mechanical Properties of Elastic Fluids.*

About 24 elastic fluids are at present known; the most familiar of which are atmospheric air, carbonic acid gas, hydrogen gas, carbonated hydrogen gas, sulphurated hydrogen gas, steam, and vapour. The several gases, though they differ essentially in their chemical properties, resemble common air so completely in their mechanical properties, that an account of the latter will be sufficient. Air is a transparent, invisible, elastic fluid. That air is a substance possessing all the properties of other matter, appears from several familiar observations and experiments. When a vessel, such as a bottle or a tumbler, contains nothing visible, or when its ordinary contents have been poured out, we are accustomed to say it is empty; but this is a very erroneous expression. The fact is, that it is then full of air. When we turn a bottle full of water with its mouth downwards, the gurgling noise produced, as the water flows out, is occasioned by the lighter air rushing up through the water to supply its place, and it may be seen rising in bubbles into the inverted bottle. If what is called an empty tumbler be inverted into a vessel of water, it requires considerable force to make it descend, and all the force we can employ will not make it descend so far, that the water shall rise within it, to the same height as the surrounding water. This is evident, if we stuff the bottom of the glass with paper, which will remain dry on lifting up the tumbler; or if the tumbler be inverted over a piece of cork, which will obviously continue below the surface of the surrounding water. In this experiment the water is prevented from rising far into the tumbler by the resistance of the included air. Again, if a bladder be filled with air, and its neck properly secured, the same resistance prevents the sides of the bladder from being brought together, unless the force be so great as to burst the bladder. The resistance, and of course materiality, of the air, is farther evinced by the opposition which it gives to bodies moving quickly through it, and still more by the irresistible force with which a violent wind strikes opposing objects. The transparency of the air appears from the facility with which objects are seen through it; and though a serene atmosphere appears blue, air in small quantities is evidently colourless, and therefore invisible. It is, however, rendered visible when passing through another fluid, as water, by the brilliancy which it then exhibits. Its resistance shows that air consists of solid particles, though these particles are so minute that it is impossible to estimate their bulk. The smallest form in which we see them is that of the minute bubbles, not bigger than a small pin head, which rise in a glass of sparkling cyder or champagne.

*Gravity of the air.*—As light as air, is a common proverbial expression; but nothing is more certain than that the lightest air has weight. This is proved by weighing a thin empty bladder in a nicely balanced pair of scales, then filling it with air, and weighing it again, when its weight will be obviously increased. According to the latest experiments, it appears that a cubic inch of air, at the temperature of 60°, and when the barometer stands at 30 inches, is 0.305 of a grain, or 100 cubic inches weigh $30\frac{1}{2}$ grains. Comparing air with water, the weight of the former is to that of the latter as 1 to 832. From this property of air, it is clear that it must press with a certain force on objects immersed in it; and by comparing the pressure of a column of mercury with that of a column of the atmosphere having an equal base, it is proved that the pressure of the air is equal to about 15 lbs. on every square inch, and that the body of a middle-sized man is subjected to the pressure of several thousand lbs. The pressure is exerted in all directions, otherwise it could not be sustained. As the atmosphere is composed of an indifferent number of strata or layers, the upper pressing on the lower, it is evident that the pressure of a column of air is in proportion to its height, and diminishes as we ascend higher above the surface of the earth. The consideration of this important fact, and its application to several useful purposes, will be resumed in the subsequent sections of this chapter.

The *fluidity* of the air is proved by the facility with which its particles are displaced, by bodies moving through it; but it differs from liquid fluids, especially from water, in several important particulars. Unlike them, it cannot be rendered solid by the greatest degree of cold yet observed or produced. Its density can be increased or diminished to a great degree without altering its nature and physical properties, and, above all, it is highly elastic. The *elasticity* of air, or that property by which it is capable of compression and expansion, is shown by many simple experiments and observations. We know that a bottle of fermented liquor, in a brisk state, contains a much greater quantity of air than the bottle itself without the liquor could naturally hold; as appears from the force with which the cork is often expelled, and the liquor projected to a considerable distance, and from such bottles frequently bursting when exposed to heat, while they remain uninjured in the cold. By a contrivance, to be afterwards described, many times the ordinary bulk of air may be forced into a vessel, and when suffered to expand the air will rush out with great violence. A bladder, half filled with air, is flaccid; but if it be exposed to heat, it becomes plump by the expansion of the included air, and if the heat be increased, and the bladder thin, the latter will burst.

*Steam*, or the fluid compound of water and heat, possesses all the mechanical properties of air; but it differs from this fluid in easily parting with its heat, and being thus condensed into water, and losing its elasticity. In its usual state, steam is visible. It is much lighter, and consequently rarer than common air, as appears by its rising into the atmosphere. It is found that a cubic inch of water, when converted into steam, occupies the space of a cubic foot, or is expanded into 1728 times its original bulk, whence it appears that its density is to that of air nearly as 5 to 11. Its specific gravity is not easily determined by experiment; but by calculation it is to that of air as 0·467 to 1. Its elasticity is greater than that of air. In Papin's digestor, it is compressed into a very small bulk, even at a red heat; and its great expansibility is evident from its sometimes bursting the strongest boiler of a steam engine. In this property of expansion it exceeds the elastic fluids evolved in the explosion of gunpowder, and has been lately proposed and employed as a substitute for that substance.

*Vapour* is a combination, or mechanical mixture of air and water. In its usual state, as exhaled from a moist surface, it is invisible; but when collected into masses in the atmosphere, it assumes the visible form of clouds. Its mechanical properties have not been fully investigated. From the great elevation at which clouds often appear, it is evident that vapour is more than twice as light and rare as the air at the surface of the earth, but it seems to possess little elasticity. By means of cold and electricity, it is converted into water, snow, or hail, though it may remain for a considerable time in the atmosphere without undergoing these changes.

### SECT. II. *On Pneumatic Equilibrium.*

In this section is to be considered what is strictly called the theory of pneumatics, or those laws or principles by which elastic fluids are regulated in their quiescent and moving state. Here it will be necessary to retrace what has already been given under the preceding section, and to refer to several instruments and contrivances to be described in the last chapter of this treatise.

*The pressure of air*, arising from its gravity, is measured by the height at which it is capable of suspending a heavier fluid within a close tube. If a glass tube, closed at one end, such as is used in constructing common barometers, be filled with mercury, and inverted, with the open end stopped with the finger, into a vessel containing the same fluid;—on removing the finger the mercury will subside in the tube, and remain at the height of about 29 or 30 inches. In this experiment, the part of the tube above the mercury is entirely empty, or forms a *vacuum*. The whole pressure of the external air is exerted on the surface of the mercury in the vessel, and prevents the mercury in the tube from descending lower. Hence the mercury and the air are *in equilibrio*, or balance each other. That the suspension of the mercury is owing to the pressure of the external air, is easily proved. If a bent tube be introduced, through the mercury in the vessel, below the mouth of the tube, and a little air be blown through it, it will rise through the mercury to the top of the tube, and the mercury will immediately descend in proportion to the quantity of air introduced, till it entirely subside to a level with that in the vessel. Here the pressure of the external air is lessened, or counterbalanced by the air included within the tube. A still more satisfactory proof is obtained, by placing the tube and vessel within a very tall receiver of an air-pump, and exhausting the air within. As the exhaustion proceeds, the mercury gradually falls in the tube, till it attain nearly the level of that in the vessel.

If a tube were constructed of copper or iron, about 30 feet long, having a glass tube like that first described, but about six feet long, cemented to the former by its open end, so as to make the whole perfectly air-tight,—and if this compound tube be filled with water, and inverted in a vessel of water, the fluid within the glass part of the tube would subside till it remain at the height of about 33½ feet. This experiment is not easily made; but the same fact is observed in raising water by a common pump, and it is found that, with this instrument, the water cannot be raised from a greater depth than 33½ feet. Hence water at this height is *in equilibrio* with a column of air reaching to the top of the atmosphere, and having the same diameter as the water in the tube or pump.

The pressure of the atmosphere varies according to the height of its column. Numerous observations have proved that the mercury in a barometer stands highest at or below the surface of the earth, and that it gradually diminishes in proportion as the instrument is elevated above that surface, by being carried to the top of a mountain, or attached to a balloon. It is found that this diminution of pressure, at various altitudes, observes a certain fixed law. Thus, if the altitudes increase in an arithmetical progression of 1, 2, 3, &c. the pressure will diminish in a geometrical progression of 2, 4, 8, &c.; that is, if at the height of 3½ miles above the level of the sea, the pressure of the air be one-half of what it is at that level, at the height of seven miles it will be diminished to one fourth; at the height of 10½ miles to one-eighth, and so on for greater altitudes in the same proportion. The pressure of air, and other elastic fluids, is in proportion to their density,—as is evident from the experiment with the air-pump above described, in which, as the air was rarified, its pressure on the mercury diminished. Now, as the air becomes rarer in proportion as we ascend into the atmosphere, according to the law first laid down, its pressure must diminish in the same proportion. On this principle chiefly is founded the method of measuring heights by the barometer, of which a short account must be here introduced.

*Measuring of heights by the barometer.*—For this purpose are required a barometer, to which is attached a thermometer, placed as near as possible to the barometrical tube, a second separate thermometer, and a table of logarithms. The method now followed in this country consists in observing the height of the mercury on a plain, as near as possible to the foot of the mountain or other height to be measured, and the temperature of the air and the mercury in the same situation, as indicated by the two thermometers, then carrying the instruments to the elevation to be measured, and making similar observations there. The subsequent part of the process depends on algebraical calculation, according to *formulæ* founded on the experiments of De Luc, Shuckburgh, and Roy. It is as follows: Having ascertained the densities of the air below and above, the logarithms of the two heights denoting those densities are taken from the tables, and the less subtracted from the greater; the remainder is multiplied by $m$, and the product expresses the height in fathoms. Expressing the height of the barometer below by B, and the height above by $b$, the height to be measured is equal to $m$ (L B, L $b$.) Now, it has been proved, that when the thermometer stands at 32°, the symbol $m$ is equal to 10.000. Hence, at that temperature, the rule is, to subtract the logarithm of the height of the barometer above from the logarithm of its height below, reckoning the first four figures as integers, the remainder gives the height in fathoms, and, multiplied by 6, in feet. At all other temperatures two corrections are necessary, one for the temperature of the mercury, and another for that of the air. It has been observed that, for every degree of cold, the column of mercury is shorter than it should be by 0.000,05. If this fraction be multiplied by the number of degrees of cold, and the product be multiplied by the height of the barometer, this last product will give the correction for the mercury, which is to be added to the height of the barometer. The height thus corrected may be expressed by $b'$. To find the correction for the temperature of the air, let its temperatures below and above, as observed by the separate thermometer, be expressed by $t$ and $t'$ respectively. These must be added together, and their sum divided by 2. If the quotient be 32°, no correction for the air is required, but if otherwise, 32 must be subtracted, and the remainder be multiplied by 0.00244, the mean of the change in the bulk of air occasioned by one degree of Fahrenheit, according to the experiments of Shuckburgh and Roy. This may be expressed symbolically by $\left(\frac{t+t'}{2}-32\right)0{\cdot}00244$. Hence the general algebraical formula for any required height at any temperature, except 32°, will be $\left(1+\left(\frac{t+t'}{2}-32\right)0{\cdot}00245\right)\frac{\text{L B}}{6}$. This formula gives the height in fathoms, when the first four figures of the logarithms are received as integers.

The pressure of the air, under ordinary circumstances, is balanced by a counter pressure on the other side, or within the body pressed on. This fact is best shewn with the air pump. When the receiver of that instrument is placed on the plate, before the air is exhausted, it can be easily removed; but after exhaustion, it is extremely difficult to raise it. In the former case, the pressure of the external air is compensated by that of the air within the vessel; but in the latter, as the pressure from within is removed, the external air exerts all its weight in keeping down the receiver.

The *resistance* of the air is in proportion to its density, and to the extent of surface in proportion to its bulk which a body presents to that resistance. Aeronauts have observed, in descending with a parachute from a considerable height, that their motion through the air is at first very rapid, but becomes gradually slower as they approach the surface of the earth, a circumstance evidently owing to the increased density of the air as they descend. A furled fan meets with little resistance in striking the air; but when unfurled, its increased extent of surface occasions such resistance as renders the motion of the fan more difficult. If a guinea and a feather be let fall from the same height in the open air, the former will reach the ground sooner than the latter, on account of its less extent of surface in proportion to its bulk; but if the same experiment be made from the top of a tall receiver, exhausted by the air-pump, they will both fall at the same moment, from not meeting with any perceptible resistance. See Fig. 1. Plate 152.

The air's resistnce when in motion has already been noticed in the first section, and its effects will be exemplified in the next chapter.

The elasticity of the air is in proportion to its density, and the force by which it is compressed. This is proved by the working of an air-pump. When the exhaustion commences, it proceeds with ease and expedition from the greater density and consequent elasticity of the air in the receiver; but as that air becomes more rarefied, its spring gradually diminishes, and at last becomes unable to raise the valves through which the remaining air should escape. The common pop-gun affords a good illustration of both parts of the proposition. When the first plug is driven to the farther extremity of the tube, and the second is gradually forced in with the piston, the compressing force increases the density of the air included between the two plugs; and when this density attains a certain height, the elasticity of the air is so much increased, that it forces out the farther plug with considerable violence. The air-gun affords a stronger proof of the same fact. See Chap. III.

The space occupied by any given quantity of air is inversely as the force which compresses it, and its density is in direct proportion to that force. If a small quantity of mercury be poured in to the bent tube, *n*, *k*, *g*, Fig. 2, having the extremity of the shorter leg *g* closed, and the other end open, the two columns of mercury will be nearly on a level; but the air included within the shorter leg will be condensed into a smaller space. If more mercury be poured in, it will raise the column of that fluid in the shorter leg, and still more condense the air. If the additional quantity of mercury be of the same length as the column of mercury in a barometer at the time, the pressure on the air in the shorter leg will be double that of the atmosphere, and the bulk of the air will be reduced one half, or will occupy the space *g h*, while its density will be doubled.

*The effects of condensed air* depend chiefly on its increased elasticity; and experiments on these effects are usually made with the instrument called a *condenser*, (see Chap. III.) The following are the principal effects of condensed air. It increases the sound of a bell or other sonorous body; it breaks a square phial exhausted of its air; it produces a *jet d'eau* by pressing on the surface of a fluid in which is immersed an open tube. This effect may be illustrated by a very simple apparatus, consisting of a globular glass vessel, half full of water, into the neck of which is fixed a tube, with its lower extremity a little curved, the juncture of the tube and neck being made air-tight by cement. On blowing strongly and repeatedly through the tube, the air in the upper part of the vessel will be increased and condensed, and, pressing on the surface of the water, will force part of it up through the tube.

*The effects of rarefied air* are, of course, of an opposite nature, and are best conducted with the air-pump. Air in such a state appears to increase the weight and pressure of the external air. If the hand be held over the top of an open receiver, while the air is exhausting, it will be gradually forced into the cavity, and cannot be easily extricated, till the air be readmitted into the receiver. If a piece of wet bladder be tied over a similar receiver, and suffered to dry, and the air be then exhausted, the

Fig. 3.

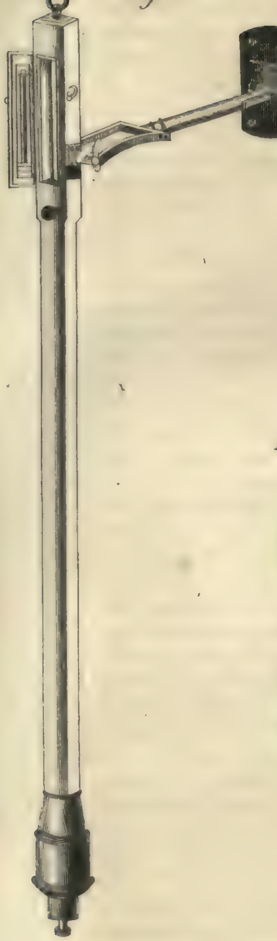


Fig. 5.

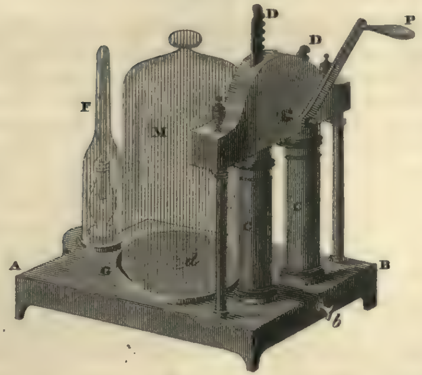


Fig. 6.

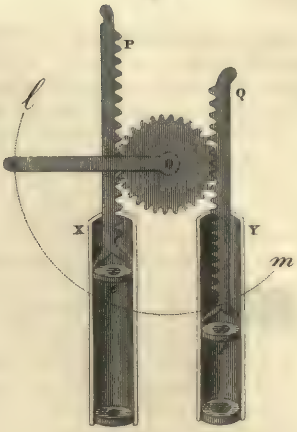


Fig. 7.

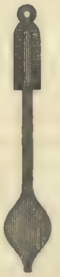


Fig. 8.

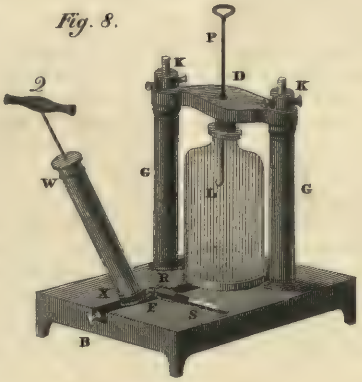


Fig. 11.

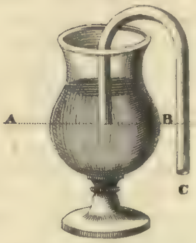


Fig. 9.

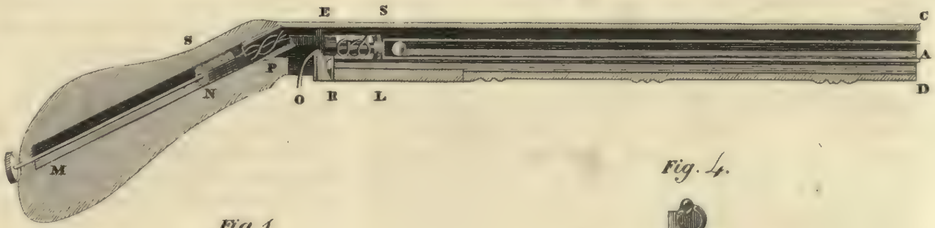


Fig. 4.

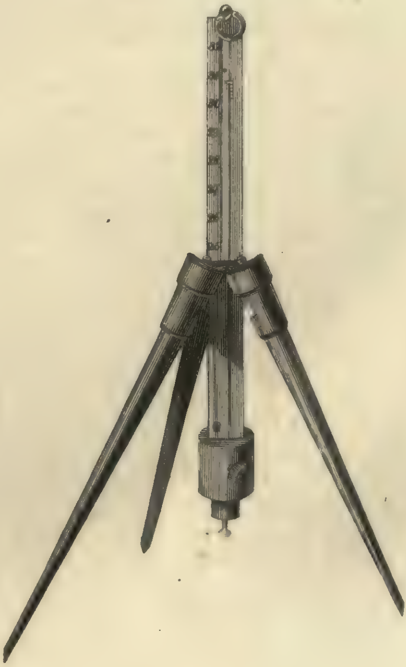


Fig. 1.

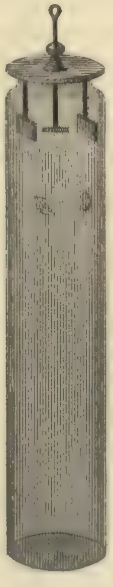


Fig. 10.

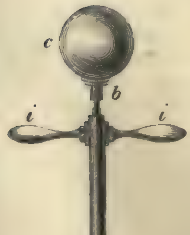
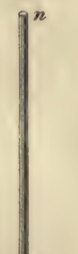


Fig. 2.



Air in motion.

bladder will be pressed down in the form of a cup, and will at last burst with a violent report. This effect is occasioned by removing the counter-pressure of the air within the receiver. Rarefied air appears to increase the elasticity of the air contained in bodies exposed to the former. A square phial full of air, placed below the receiver, will burst when the air around it is sufficiently rarefied; a flaccid bladder, under the same circumstances, will become plump. Water considerably below the boiling heat, placed in a tumbler below the receiver, will, as the exhaustion proceeds, throw up bubbles of air, and appear to boil. Cold ether will very soon exhibit a similar appearance. In these instances, too, the balance between the air in the bodies and that around them is destroyed, so that the former is suffered to exert its full elasticity. Rarefied air empties the pores of bodies immersed in it. If a piece of dry wood be introduced, by means of a wire, into the receiver, and, when the air is exhausted, the wood be pushed down into a vessel of mercury, and the air be readmitted, the mercury will be forced into the pores of the wood, and be visible when this is cut open.

*The elasticity of steam*, like that of air, is in proportion to its density, as appears from the experiment already noticed with Papin's digestor. The same experiment shews that its elasticity is increased by heat. At the ordinary temperature of 212°, it is capable of balancing a column of mercury equal to that in the barometer; but if its temperature be raised to 240°, its elasticity and pressure are nearly doubled, or, according to Dalton, it is then capable of balancing a column of mercury nearly 52 inches high.

*The elasticity of vapour* is illustrated by the peargage, to be afterwards described under air-pump. It is greater in proportion as the air is saturated with moisture; and, as in other elastic fluids, it is increased by heat. The law of increase in both cases has been nicely calculated by Dalton, and Gay-Lussac; and as it involves many algebraical formulae, we must refer to Dalton's Chemical Philosophy for the results.

### SECT. III.—*Of Elastic Fluids in Motion.*

This part of the subject has been nearly anticipated under METEOROLOGY, which has left for this section only a few observations on the velocity of different winds, and the force with which wind strikes on the sails of a ship.

The velocity of the wind is in proportion to its violence, from that of the lightest breeze to that of the most furious hurricane. It is calculated that the former is equal to one or two miles per hour, and the latter to 100 miles per hour. Between these, there are, of course, infinite gradations. Mr Smeaton has constructed a table, shewing the principal velocities of wind, according to its effects, of which the following is an abstract: Pleasant gentle breezes commonly move at the rate of from 3 to 5 miles per hour; very brisk wind from 10 to 25; high winds from 30 to 35; very high winds from 35 to 45; tempestuous winds 50 to 60; and ordinary hurricanes 80.

A ship is impelled through the water by the force of the wind striking on its sails; and it is demonstrable, that when the velocity of the air and the dimensions of the sail are given, the force with which the wind strikes the sail is as the square of the co-sine of the angle of incidence, and will, of course, be great in proportion as it strikes the sail more perpendicularly.

Phenomena.

## CHAP. II.—PHENOMENA CONNECTED WITH PNEUMATICS.

THE observations under this head, in addition to what have been given in preceding parts of this Work, especially ACOUSTICS, AEROSTATION, ANATOMY, DIVING-BELL, and METEOROLOGY, relate chiefly to the general influence of air in the animal economy, the nature and cause of suction, the agency of elastic fluids in producing certain convulsions of nature, and some particular atmospherical phenomena not already noticed.

The air, by its pressure and elasticity, exerts a beneficial, and even necessary influence, in the animal economy. In proportion as the gravity of the atmosphere is greater, as indicated by the rise of the barometer, the animal motions are invigorated, the spirits enlivened, and the natural functions are carried on with activity and ease. On the contrary, when the pressure is diminished, or the mercury in the barometer depressed, the animal motions are sluggish, and performed with difficulty, the spirits are depressed in proportion, and the functions partake of the general inactivity. A certain degree of pressure is necessary for preventing the too great expansion of the elastic fluids contained within the vessels and cavities of the body, as appears from the effects experienced by persons who ascend to the top of very high mountains, or rise into the higher regions of the atmosphere in balloons. In these elevated situations the respiration becomes short and difficult, from the diminished density of the air with which the lungs are expanded, and not unfrequently hemorrhage is produced from the lungs, ears, nose, or even other parts of the body, by the increased elasticity of the included air and vapour.

*Ventriloquism.*—The mechanism of ordinary respiration and voice has been explained under ANATOMY, but there is one singular modification of voice which requires to be here noticed, namely, that peculiar talent possessed by some persons, of making their auditors believe that the sounds which they utter proceed not from the real speaker, but from others at a distance or in a different apartment. This talent has been called *Ventriloquism*, from an idea that the voice of the speaker comes from the belly and not from the mouth. Several ventriloquists have contributed to the amusement of the public, by their extraordinary imitations not only of the human voice and that of other animals, but of various discordant sounds arising from the motion of inanimate objects. One of the most remarkable of these performers was M. Fitzjames, who exhibited at London in 1803. A very entertaining account of his performance was given by Mr Nicholson in the 4th vol. of his *Philosophical Journal*, 8vo., to which we must refer the reader.

It is not easy to explain the method by which these persons exert their remarkable talent; but, on the whole, the explanation given by Richerand, and founded on personal observation of the ventriloquist just mentioned, seems to be the most plausible. That physiologist remarked, that the artist always made a strong inspiration before commencing his exhibitions, and he could perceive an unusual distension about the pit of the stomach, and hear the air rolling sometimes even lower. The increased quantity of air, thus taken into the lungs, appears to have been expelled by a slow and gradual expiration, regulated by an adroit management of the muscles of the chest, and the voice was probably modulated by keeping the tongue back, so as to press with various degrees of force upon the epiglottis. Hence, he concludes, that this art is effected partly by the gradual expulsion and skilful management of an unusual quantity of air taken into the chest, and partly by the influence which the performer acquires over the imagination of his hearers.

*Suction* was long supposed to be an active operation, by which not only animals but certain machines draw up fluids into their mouths or cavities; but the science of Pneumatics proves that, even in the former, the process consists in exhausting the part or body from which the fluids are to rise, and thus allowing the external air to exert its full effect in pressing up the fluids. This is easily shewn by the effect of a common syringe in the open air and in an exhausted receiver. In the former, when the piston of the syringe is raised, while its open extremity is immersed in a fluid, the air within the tube is exhausted, and the fluid rises into it by the pressure of the atmosphere; but when the same process is repeated, by a particular contrivance, in the exhausted receiver of an air-pump, no fluid rises into the syringe. The operation of cupping, in surgery, affords another illustration of the same fact. When the air in the cupping-glass is rarefied by heat, or with an exhausting syringe, and the glass is applied to the body, the pressure of the external air forces it down on the skin, and the part covered rises up into the glass, and if orifices have been made in the part, the blood flows from them in consequence of the balance between the external and internal air being destroyed. The force with which some animals adhere to the surface of bodies by means of their suckers, and the faculties possessed by geckos, tree-frogs, and flies, of walking up a perpendicular wall, or suspending themselves in an inverted position, are explained on the same principle. See Erpetology and Entomology. Whatever may be considered the principal causes of earthquakes and volcanos, there can be no doubt that the elastic fluids pent up in the bowels of the earth, and expanded by heat or accumulated by condensation, may act as very powerful agents in those convulsions of nature. It is probable that, in volcanic mountains, steam is often formed in great quantity below the heated bottom of the crater, under a considerable degree of pressure, and the expansive force it then exerts is sufficient, not only to produce an eruption from the original crater, but to force its way through the solid sides of the mountain. These observations are confirmed by the effects of elastic fluids extricated in the explosion of gunpowder in blowing up rocks, and separating large masses of stone in quarries. The force of this explosion in mining, and its effects in propelling missile weapons, will be considered under *Projectiles* in the principles of War.

A few variable winds remain to be noticed in this chapter, as hurricanes, whirlwinds, and tornados.

*Hurricane* is a general name for those tempestuous winds which throw down buildings, uproot trees, overset ships, and commit similar devastations. These winds are most violent and destructive in the tropical regions, especially on the coast of India, and in the West India islands, where they have often laid waste extensive districts, demolishing the crops, and levelling the buildings with the ground. Ships caught in these hurricanes are compelled to cut their cables and stand out to sea, or they would be inevitably dashed to pieces on the shore. These winds are the more dangerous as they often come on suddenly, or are preceded by a deceitful calm, which only experienced mariners, or those who make use of the marine barometer, foresee is the prelude of an approaching storm. One of the most remarkable hurricanes that have taken place in the West Indies, was that which happened at St Lucie in 1818, in which the governor, General Seymour, lost his life by the fall of the government-house. Some severe hurricanes occasionally happen in our temperate climates, and a very memorable one occurred in most part of Britain in 1747, on a Saturday, which is still commemorated as the windy Saturday. It is worthy of remark, that two storms, scarcely less destructive, took place in Edinburgh and its neighbourhood on two successive Saturdays, Dec. 25. 1806, and Jan. 1. 1807. These winds generally blow with a steady gale from one point, as the north-east or south-west, and terminate in heavy rain. Their causes have not been satisfactorily explained; but as they generally occur in mild weather, it is evident that the atmosphere over the district to which chiefly they are confined must be in a state of unusual rarefaction,—a circumstance which is proved by the great depression of the barometer at the time.

*Whirlwinds* are variable winds of partial extent, in which the air seems to rush from all points of the compass towards a central spot, and there forms an eddy in the atmosphere, which carries round light objects with considerable velocity, and raises them high into the atmosphere. Like hurricanes, these winds are most common and destructive in tropical climates, and are there called tornados. In temperate regions, they are not only very limited in their extent, but incapable of raising any bodies heavier than hay-ricks, stacks and shocks of corn, and similar substances; but between the tropics they make a progress successively over a greater extent of surface, and sometimes involve within their eddy the smaller domestic animals, and even persons. In these phenomena, the rarefaction, which gives occasion to the influx of the surrounding air, is more considerable than in any other wind, and in consequence of that rarefaction, the lighter bodies are borne up by the denser air in the neighbourhood of the vortex, and

Instruments, &c.

Instruments, &c.

have communicated to them a centrifugal force, which whirls them round in circles. Tornados are usually accompanied with a dense watery vapour, which, as the wind proceeds, is precipitated, and forms a heavy rain.

*Waterspouts* form a species of atmospherical phenomena, which is intimately connected with whirlwinds. They always originate over the sea, or other great mass of water, and are commonly single, though sometimes several are seen at the same time, within the area of a few square miles. Their appearance has been described under GEOLOGY. Though they seem to rise from the water, some have supposed that they are first formed in the air, and gradually descend till they meet the water; but this seems to be a mistake, and it is probably owing to the same rarefaction which produces a whirlwind. The partial vacuum formed by the rarefaction of the air in the centre, allows the surrounding air to press up a column of water, nearly to the same height as it is raised in a pump, and the column is gradually expanded by the contrifugal motion of its parts. The mass of water thus raised in a large waterspout, were it to strike over a small vessel, would be sufficient to sink it, or would at least carry away part of the rigging. Hence, sailors are always on their guard when they are approaching a waterspout, and, when at a small distance, usually discharge through it a cannon ball, which, by the sudden shock it gives to the air, and probably by changing its electric state, occasions the accummulated water to disperse. For further remarks on waterspouts, so far as respects their theory, see METEOROLOGY. They are represented in Plate 128. Fig. 14.

## CHAP. III.—OF PNEUMATIC INSTRUMENTS AND CONTRIVANCES.

Many of these have already been described in preceding articles of this work,—the Æolian harp, the speaking trumpet, the hearing trumpet, and the artificial echo called the whispering gallery, under ACOUSTICS; baloons under AEROSTATION; the common barometer, thermometer, and anemometer, under METEOROLOGY, and furnaces under METALLURGY. Of those which remain to be noticed here, such as the marine barometer, manometer, blow-pipe, bellows, air-pump, condenser, and air-gun, some are strictly pneumatic instruments; others, as the syphon syringe, common-pump, forcing-pump, fire-engine, blowing-machines, steam-engines, and steam-vessels, may be called pneuma-hydraulic contrivances.

*Marine barometer.*—As the common barometer, however nicely suspended, is unfit for nautical observations on the gravity of the air, from the oscillations into which the mercury is thrown by the motion of the ship, several attempts have been made to construct an instrument not liable to this objection. The best marine barometer appears to be that of Cary, represented at Fig. 3. Plate 152. It consists of a ball filled with mercury, from which rises a tube, about one-thirtieth of an inch in its bore, to the height of 27 inches, and terminated at the top by a cylindrical tube 4 or 5 inches long, and 3-10ths of an inch in its cavity, close at the top, so that the mercury rises and falls in it as in the tube of a barometer. To this cylinder is attached a scale, with a range of about 4 inches, and the instrument is suspended near the top by a spring and jimbols, so as to prevent or counterbalance the oscillations of the mercury. For registering observations made with this instrument, naval officers are now furnished with engraved plates, contrived by Mr Horsburgh. Fig. 4. represents a portable barometer.

*The manometer*, or instrument for measuring the variations of density in elastic fluids, resembles what has been called the air-thermometer, consisting of a long glass tube of a moderate bore, surmounted by a glass ball filled with common air. The open end of the tube is immersed into a covered vessel, containing a coloured fluid, and so much of the air is expelled from the ball as to allow the fluid to rise to a certain height in the tube. When this instrument is placed in a dense atmosphere, the included air is contracted in bulk, and the fluid rises in the tube; but when the density of the atmosphere is diminished, the included air is expanded, and presses down the fluid in the tube. To fit this instrument as a manometer, it has attached to it a small spirit thermometer, which marks the temperature of the atmosphere by which the instrument is surrounded, and its variations of density are marked by the difference between the heights of fluid in the two adjacent tubes, one of which is elevated in proportion as the other is depressed, and *vice versa*.

*Blow-pipes.*—The most common form of the blowpipe, briefly noticed under GEOLOGY, is that of a conical metallic tube ending at the point in a very small orifice, and curved towards that point. The instrument of the same name used in blowing glass on a large scale, is described under GLASS MANUFACTURE. A very simple and effectual blow-pipe, used by glass-blowers for fusing or softening small pieces of glass, is formed of a glass tube 5 or 6 inches long, part of which, near the farther extremity, is expanded into a hollow ball, for condensing the vavour of the breath, and the remaining part is made conical, and bent upwards from the other side of the ball. The instrument is supported by a stand, so that the blast may be directed through the flame of a lamp, while the artist has both hands at liberty for working. The above blow-pipes are liable to two objections. They are worked by the mouth of the operator, and with an exertion which, to an inexperienced person, is difficult and laborious; and as the air from the lungs is impure, it produces much less effect than common air. These objections are obviated by using what may be called the self-acting blow-pipe. This consists of a hollow metallic ball, with a lid made to screw off and on, and fixed in a support over the flame of a lamp. From the top of the lid proceeds a metallic tube, of a conical figure, bent in such a manner that its small extremity passes below the ball, opposite the flame of the lamp. The ball is about half filled with alcohol, which, when made to boil by means of the lamp, rises into elastic vapour, rushing through the tube with considerable velocity, and not only impelling the flame against the object opposed to it, but increasing its heat. A still more effectual but rather complex apparatus of this kind, consists of two gasometers, one containing oxygen gas, and the other hydrogen gas; and from each proceeds a pipe, connected with a conical tube, which forms the blow-pipe. When the united stream of the two gases is directed against a body already heated, it considerably increases the heat, and fuses substances not easily melted by ordinary means. See CHEMISTRY.

*Bellows.*—A particular description of the common domestic bellows is unnecessary, but it is proper to explain their mode of action. The hoop, fastened within to the middle of the side leathers, prevents the boards from easily collapsing; and the valve or *flapper* is so adjusted, as easily to admit the external air, and shut so closely as to prevent its escape through the hole by which it entered. Every part of the instrument, except the valve and nozzle, should be made perfectly air tight, by glueing the leathers to the edges of the boards before nailing them, and securing the nozzle by cement. When the upper board is raised, the small quantity of air in the cavity is expanded, and more air rushes in by the valve to supply the deficiency. When the upper board is pressed down, the included air which cannot return by the valve is forced through the nozzle, and the blast thus produced will continue longer according as the orifice of the nozzle is smaller in proportion to the size of the valve hole. As some time is occupied in replenishing the bellows with air, it is evident that the blast is not continuous, but consists of puffs; and though this is a trifling inconvenience in domestic economy, it is serious in the arts connected with metallurgy. To lessen this inconvenience, the double bellows has been contrived, the most perfect form of which is seen in the forge bellows used by smiths. This contrivance consists of three boards, connected, in the usual manner, by side leathers, but forming two distinct cavities, connected only at the front, where each communicates with the nozzle. To understand the form of this instrument, it is necessary only to conceive, that to the common bellows is added an additional board below, with a hole and valve similar to those of the former, but that this additional board is held down by a weight, which prevents it from rising more than is sufficient to admit an additional quantity of air, while the uppermost board is also loaded with a weight to accelerate its pressure downwards. As the weight of the boards in this engine is considerable, it is necessary to provide a sufficient power to raise the uppermost board, and this is effected by a rope passing over a pully, with a handle attached to its farther extremity. When the uppermost board is, by this contrivance, raised, the air enters by the valves in the lower and middle boards; and when, by means of the weight, the upper board is allowed to descend, the air between it and the middle board is gradually renewed from the lower cavity, so as to render the blast much longer than in the single bellows.

*Air-Pump.*—The principal parts of this instrument are supported by a mahogany frame, A B, Fig. 5. Plate 152, standing on four short feet, nearly in the centre of which is fixed a circular brass plate G, made perfectly flat and smooth, and having a hole in its centre, with a short perforated pipe *d* over it. Near the end B of the frame, rise two solid pillars, serving as a frame to support the machinery by which the pump is worked. This machinery consists of two brass barrels, C C, in which work the pistons D D, each terminating in a rack. The pistons are worked by a winch P, to the axis of which is fixed a pinion or small wheel, which moves between the teeth of the racks, so as to raise one piston, while it depresses the other. This mechanism is more distinctly represented at Fig. 6, in which X Y are the two pistons, and P Q their respective racks, with the pinion between them. M is a glass-receiver, made very strong, closed and arched at the top, with a knob for lifting it; and having the lower edge ground perfectly smooth and even, so as to adapt it accurately to the surface of the plate. Between the central hole and the lower part of the barrels, proceeds a branching tube, let into the frame A B, so as to form between the barrels and the receiver a communication, which can be closed at pleasure by a stop-cock *b*. Each of the pistons is hollow, and furnished with a valve opening upwards, to allow the air to escape that way. At the other end, A, of the frame, is an apparatus called the barometer gauge, consisting of a glass tube, open at one end, eight or ten inches long, and about one and a half inches diameter within, filled with the purest and dryest mercury, and inverted by its open end into a vessel of the same fluid. These are enclosed within a larger glass tube, excluding the atmospheric air, but communicating with the receiver by a tube, also concealed within the frame. The use of this gauge will appear presently. Besides the close receiver already described, several others, of various heights and dimensions, some of which are open entirely at the top, while others have an open neck, furnished with a collar of leather, for introducing rods, and various other pieces of apparatus, are employed in different experiments, some of which have been noticed in the first chapter.

Before using the air-pump, it is necessary that every part of the apparatus be made perfectly clean and dry. In ordinary experiments the close receiver is employed, and the better to exclude the surrounding air, the lower rim of the glass is rubbed with a little hogs-lard, and to make it adhere more closely to the plate it is pressed down, and turned once or twice a little round upon the plate. The stop-cock *b* is then closed, and the process of exhaustion is begun. This consists in turning the winch alternately to one side and the other, as far as the racks allow, so as by turns to raise and depress the pistons. The method in which this is effected will appear from the dotted circle *l*, *m*, Fig. 6. in which the winch moves. It is evident that, when the handle moves in the direction *l m*, the rack 2 and piston Y are elevated, while the others are depressed, and that when moving in the contrary direction the situation of the pistons is reversed. When one of the pistons is raised, part of the air within the receiver escapes through the valve of that piston and fills the corresponding barrel, from which it is expelled upwards by the descent of the piston, while another portion escapes by the other piston then elevated. By these alternate abstractions of air from the receiver, the remaining part is gradually so much rarefied as to bear a very small proportion in density to the external air, and hence is capable of exhibiting the phenomena mentioned in the first chapter. The degree of rarefaction is marked by the descent of the mercury in the gauge, which is noted on a graduated scale attached to that apparatus, and still better by a contrivance within the receiver called the pear-gauge.

The *pear-gauge* is represented at Fig. 7. and is composed of a hollow bulb of glass, tapering and open below, and having cemented to it above a graduated glass tube closed at the top, where is a ring for inserting a wire by which the apparatus can easily be suspended, through a collar of leather, within the receiver, and raised or lowered at pleasure. Connected with this glass is a vessel of mercury, placed below it in the receiver. When the rarefaction has proceeded a certain length, the gauge is let down into the mercury, and the air is readmitted into the receiver. By the pressure of this air, the mercury is forced up into the tube, in which it rises to a greater height, according as the exhaustion was more complete. The small bubble of air usually floating at the top of the tube, is part of the rarefied air that had been left in the receiver, and by comparing its bulk in degrees with that of the whole cavity of the gauge, a just estimate is formed of the degree of rarefaction which had been produced. By these gauges, it is found, that a well made air-pump is capable of rendering the air within the receiver at least one thousand times rarer than that of the surrounding atmosphere.

The *condenser* is a contrivance for forcing into a convenient vessel an additional quantity of air to what it usually contains. Of this kind is the condensing syringe, with a solid piston and a valve opening downwards, while the barrel has a hole in its upper part for admitting a fresh supply of air, and its pipe is made to screw into an orifice in the vessel that is to contain the condensed air. In this instrument, when the piston is drawn up, the barrel is empty, till the piston rises above the hole, when the air rushes in and fills the barrel. By the descent of the piston, this air is forced down through the valve into the vessel, from which it cannot return by the same way, and thus by successively forcing down the piston, the air within the vessel is condensed to the required degree. Such a syringe, in connection with a receiver, forms the condensing engine represented in Fig. 8. where 2 W is the condensing syringe, and L a strong glass receiver held firmly down to a flat plate by the frame D, the screws K K, and the pillars G G. Between the end of the syringe and the receiver is a pipe of communication, and there is another pipe closed with a stop-cock for letting out the condensed air. The neck of the receiver is closed with a collar of leather, through which may be introduced the wire P, with a hook at the lower end for suspending objects within the condensed air.

*Air-Gun.*—The instrument thus called is usually made in the form of an ordinary fowling piece, which contains within it a particular mechanism for condensing air, and suffering it suddenly to expand behind a ball, or else has connected with the barrel, by means of a pipe, a vessel of condensed air, from which a portion may be conveyed behind the ball for the same purpose. The first of these contrivances is rather complex, and requires a particular description. It is represented at Fig. 9. which is a longitudinal section of the instrument The principal part of the gun consists of two brass barrels; an inner one, as A, for containing and expelling the ball, and an outer barrel surrounding the former, close at the muzzle, but open at the back of the former. Within the butt of the piece is a condensing syringe, S M N P, the handle of whose piston projects backwards. Between the two barrels is a valve E P, for admitting the condensed air, and just behind the open breech of the inner barrel is another valve, capable of being opened and shut by the trigger O. By the action of the syringe, the cavity of the outer barrel is filled with condensed air, which is prevented from escaping through the butt by the posterior valve. The ball is introduced at the muzzle of the inner barrel, and rammed down in the usual manner, and when the piece is to be discharged, the trigger is drawn back, and the valve being thus opened the condensed air presses strongly against the ball, and expels it with a force proportional to the quantity of air that comes in contact with it. If the trigger is held back entirely, the ball is acted on by the greater part of the included air, and may be propelled to the distance of nearly one hundred yards; but if the valve be quickly opened and shut, the force of explosion is much lessened, and sufficient air remains in the gun to produce three or four other discharges.

In the more modern construction of the air gun, but little description will be required. It can scarcely be distinguished, at first sight, from a fowling-piece, except that just before the guard is a short projecting tube, on which, when the gun is to be used, is screwed the vessel of condensed air, and the tube communicates with the chamber of the barrel just behind the ball. The vessel for holding the condensed air is a hollow copper ball *c*, Fig. 10. to the neck of which is screwed the end of a condensing syringe *a b*, the piston of which is furnished with a long handle, on which are placed the feet, while there is another handle *i c*, at the extremity *b*, by which the barrel of the syringe, with the copper ball, is worked up and down upon the piston, and in this way the ball is filled with condensed air. The neck of the ball is furnished with a valve opening inwards, and preventing the included air from escaping, unless the valve be pushed back. When the vessel, thus charged with condensed air, is screwed on the gun, and the ball introduced into the barrel, nothing more is required to discharge the piece, but to draw the trigger, and thus throw down the lock, to which is attached a wire that passes through the tube and neck of the vessel, so as to press down the valve, and thus allow a sufficient quantity of condensed air to enter the chamber and expel the ball. Enough of air is still left in the vessel to produce several more discharges. A third modification of the air-gun, called the magazine air-gun, represented at Fig. 1, 2. Pl. 153. has been contrived, for including within it not only a large quantity of condensed air, but also several bullets, which are successively brought within the barrel by an ingenious but complex mechanism. The instrument is unwieldly, and is seldom employed.

The *syphon* is an instrument for drawing off clear liquor from the lees or sediment, by the pressure of the external air. Its most simple form is that of a bent glass or metallic tube, with one leg longer than the other, and open at both ends. When such a tube is filled with some of the liquor to be drawn off, and while both ends are stopped with the fingers, the shorter leg is introduced into the fluid, the latter immediately begins to flow out from the longer leg of the syphon, and will continue to flow, as long as the liquor covers the extremity of the shorter leg. This simple operation is illustrated by Fig. 11, Plate 152, where A B is the vessel containing the fluid to be drawn off, and C the syphon. To explain the action of the syphon, it must be observed, that, though the two extremities of the tube sustain nearly equal atmospheric pressures, those pressures are counterbalanced by unequal columns of fluid, and, therefore, the pressure against the column in the shorter leg must have a greater effect than that against the longer column, therefore the latter must give way and a flow must be produced.

The syphon just described is adapted only to fluids in open vessels; another is now generally used for drawing off liquor from the bung-hole of a barrel. It is an angular tube, formed of tin plate, the branches of which diverge from each other, and near the top of the longer leg is a hole, to which is soldered a short tube, a little curved; when the shorter leg is introduced into the barrel, the air is exhausted by sucking it with the mouth by means of the small tube, so as to bring the fluid into the longer leg, from which it will then flow in a continued stream, as long as the orifice of the shorter leg is covered.

*Syringe*.—The form of the common syringe is too familiar to require description; but the manner in which it is made to discharge the water differs according to circumstances. Sometimes, as for surgical purposes, the syringe terminates in a slender pipe, or in a close cap with several perforations, according as the liquor employed is to proceed in a single, or a divided stream. In several cases, as in gardening, and in accidental fire confined to a small spot, a large wooden syringe, terminated by a rose like that of a watering-pot, is very convenient. The manner in which this simple engine acts is sufficiently explained under Chap. II.

*Pumps* are of two principal kinds,—the *common* and the *forcing* pump. The mechanism of the former is illustrated by the model represented at Fig. 3. Plate 153. the principal part of which is made of glass, in order to see the effect of the pumping process. The part B of this model answers to the well or reservoir out of which the water is to be raised, and A D to the shaft up which the water rises. This shaft, in ordinary pumps, consists of a cylindrical wooden tube, not more than forty feet long, including the part below the water called the working barrel, and open at both ends. The lower end is plunged below the usual surface of the water, and has a kind of grating to prevent sand and other impurities from rising into the shaft. Above the grating is a hollow plug, firmly fixed, with a valve C opening upwards, and within the upper part of the shaft is a piston or sucker, A D, made air and water tight, and having a heavier valve D at the bottom, also opening upwards. To the top of the piston is attached a handle, which is usually moveable up and down by a joint, and is suspended near its middle by a bolt, on which it turns loosely.

When the shaft of the pump is first fixed in the well, it is evident, that the air it contains is of much the same density, as that of the atmosphere that surrounds it; is that the water stands at much the same level in the well and in the shaft. But when the piston is raised, the air above the plug is rarefied, and more air rises from below;—by again raising the piston this air is also expanded, and some water rushes up through the lower valve. By successive strokes of the piston, and the escape of the air, during its descent through the upper valve, the air in the shaft is exhausted, and by the pressure of the external air, the water is forced up, till it rises to the spout, and flows out. In the ordinary wooden pump, this flow is interrupted, and requires the continued motion of the piston, to raise a sufficient quantity of water; but in what are called leaden pumps, this inconvenience is obviated, by a cistern at the top of the pump, represented in Fig 3. at A. In such pumps the cistern is soon filled, and the flow from the spout is more continuous. The *forcing pump* is a contrivance for raising water to a much greater height than it can be raised by the common pump, and is employed to convey water to the upper parts of dwelling houses and manufactories. Its mechanism will be undersood from the model represented at Fig. 4. Plate 153.—*e f*, is the shaft or working barrel, with a plug and valve opening upwards at *n*, and H K is the piston, terminating at K in a solid plunger. From one side of the barrel, above the plug, is another tube at B, communicating with the barrel, and terminating above in an expanded part or reservoir. Into the top of the reservoir, and extending nearly to its bottom, is fixed a smaller tube *b b*, which for experiments may be straight, but for other purposes is generally curved at the top. In this instrument, when the piston is raised, the water rises in the barrel, as in the common pump, till it gets above the side tube; but when the piston is pushed down, as the water cannot escape by the valve *n*, it is forced into the side tube, and is gradually accumulated in the reservoir. By this accumulation, the air in the upper part of the reservoir is condensed, and presses on the surface of the water, so as to force it up through the small pipe, from which it will continue to flow as long as the pump is worked.

*The fire engine*, or instrument for extinguishing accidental fires, consists of a cistern for holding the water, having fixed in it two forcing pumps, the pistons of which are furnished each with a double lever, or handle, so as to admit of their being worked by several persons at the same time. Connected with both pumps, by means of proper tubes, is a cylindrical reservoir, from the upper part of which proceeds a pipe, part of which is flexible, and to the end of which is screwed a long flexible pipe, through which

*Fig. 1.*

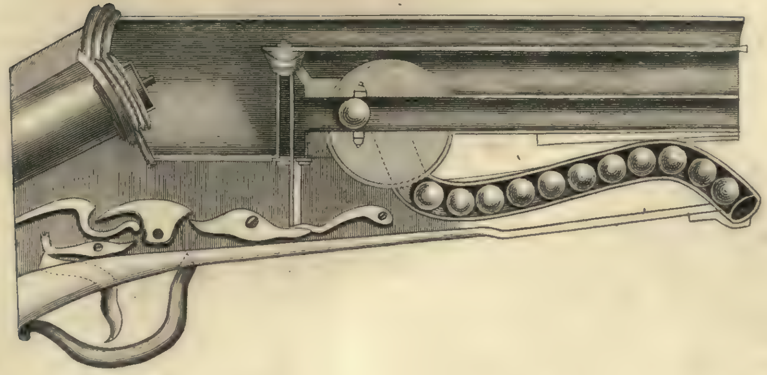


*Fig. 3.*

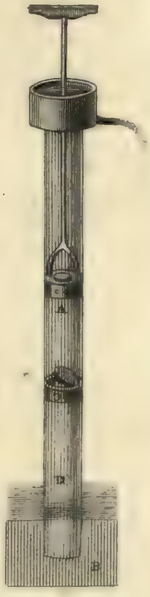


*Fig. 4.*

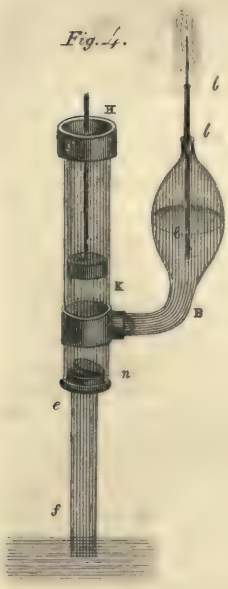


*Fig. 2.*

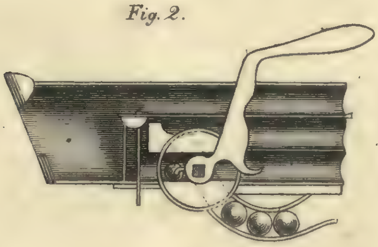
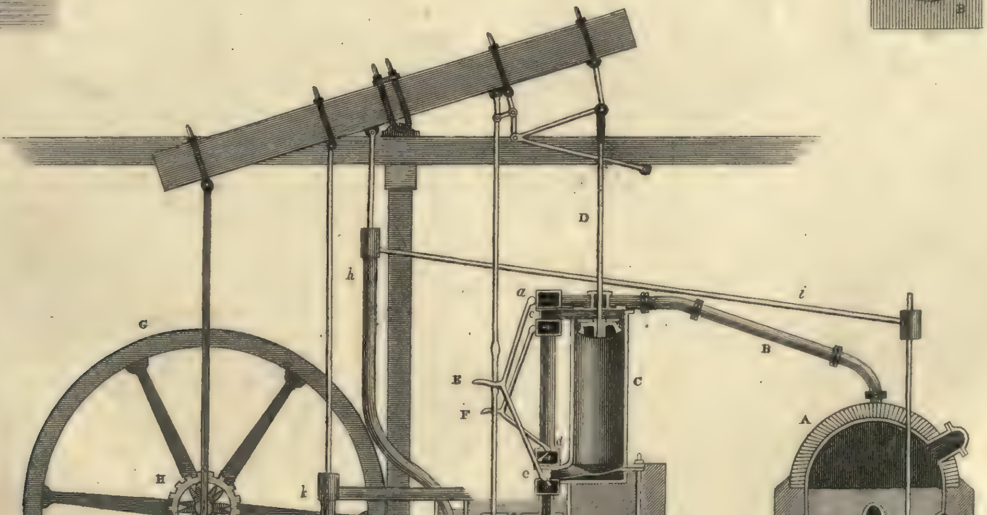


*Fig. 5.*

## WATT'S, STEAM ENGINE



E. Mitchell sculpt

the water can be directed to any required spot, and to a considerable height. This apparatus is so contrived, that it can be placed within a case or frame, supported on wheels, for conveying it expeditiously from place to place; but when it is to be used, it is generally taken from the support and placed on the ground. The action of this important engine requires little explanation. The two forcing-pumps supply the reservoir, and, by the pressure of the condensed air in the upper part of that vessel, the water is forcibly expelled through the flexible tube, the flow from which will continue as long as the pumps are worked and the cistern is supplied with water. The effect of such an engine will be in proportion to its size; and as, from the long continued friction, the apparatus is soon worn, great attention should be paid to repair any defect, before the engine be again called into use.

In very high buildings, such as many of the houses in Edinburgh, where, during the years 1824 and 1825, fires have been more frequent and more destructive than was ever before known in that city, it is often impossible to reach the flames by employing the engine-pipe in the usual way. To remedy this defect, recourse has been lately had to two methods. One is, to use what is called the triple ladder, which is composed of three ordinary ladders joined together at the top, and diverging below to make them stand securely with a small railed platform above, so that a fire-man, standing on it, may direct the pipe wherever required; but as, in this service, much danger is incurred from the fall of stones or chimnies, it is safer to employ a machine composed of three long poles, fastened together at the top, and surmounted by a beam or yard, moveable in all directions by means of ropes and pullies; so that a long flexible pipe, fastened to the beam, may be adjusted from below, without the risk of injuring the firemen or their assistants.

Where water is near at hand, and can be obtained from the fire-cocks common in most large towns, the place of the fire-engine may be supplied by a portable forcing-pump, fixed on the fire-cock, and having attached to it the usual flexible tube.

*Blowing machines.*—The blow-pipes and bellows already described are properly *blowing machines*, as they are used to increase the heat of burning combustibles; but this name is now generally restricted to certain instruments, in which, by alternate rarefaction and condensation of air, by means of water, a current is produced, and directed to the furnace with more uniformity and effect than by the bellows. Several of these machines have lately been constructed; and among the best are the patent machines of Mr Street, particularly described in the *Repository of the Arts*, vol. xviii. Their general construction, and mode of action may be understood from the following outline.

A barrel-shaped vessel, four or five feet in diameter, and of such a length as circumstances may require, is supported on an axis between two posts like a barrel churn, and turned round with a winch. The vessel is divided lengthwise, into two equal cavities, by a partition accurately fitted to one side and the two ends, so as to be water tight, and reaching almost to the other side, and the partition is perpendicular when the barrel is at rest. The vessel is almost half filled with water, and is made to turn on its axis, backwards and forwards, about a quarter of a round. By this motion, the air in the upper part suffers two changes; that in the depending part of the vessel being condensed by the pressure of the water inclining to that part, while the air on the other side of the partition suffers a proportional rarefaction, from the retiring of the water. To produce a current, four valves are placed at one end of the barrel, two on each side of the partition, in such a manner that one on each side shall open inwards, while the other two open outwards. By this construction, on whichever side the air is rarefied by the oscillations of the vessel, fresh air will rush in on that side by the inner valve, while the condensed air on the other side will flow out by the outer valve. To collect and concentrate the air issuing from the outer valves, a vessel is attached to that end of the barrel, so as to include those valves, while it excludes the others. This last vessel has a close top, from which proceeds a perpendicular partition nearly to the bottom, and it contains a quantity of water, through which the alternate puffs of air are propelled to a nose pipe, which communicates with both cavities and with the fire, and keeps up a uniform blast, as long as the barrel is kept in motion.

*Steam-Engine.*—This extraordinary machine, which has long been employed for freeing mines and coal pits from superfluous water, and is generally used in large manufactories to supply the place of the more expensive labour of men and horses, consists of an apparatus for applying the elastic force of steam to the piston of a cylinder, to the upper part of which is attached one end of a moveable beam, while the other end is connected with a forcing-pump or other contrivance, according to the work which the engine is required to perform.

*Watt's Steam-Engine* was long considered the most perfect kind. It is represented at Fig. 5. Pl. 153; where A is the boiler for converting water into steam. It is usually of an oblong form, has a concave bottom, and is so fixed over the furnace that the flame can play round it. There are commonly two boilers to the same engine in case of accident, or that one may be in use while the other is repairing. B is the steam-pipe for conveying the steam from the boiler to C, the cylinder, in which works the piston D, within a collar of leather. The steam is admitted to the upper part of the cylinder by the valve *a*, and to its lower part by the valve *c*, so as to press down the piston in the former case, and force it up in the latter. The steam is conveyed from the cylinder to a condenser *e*, through two eduction valves *b*, *d* This condensor is placed in cold water, and has a jet of the same fluid continually playing within it. The condenser is emptied both of air and water by means of the pump *f*, the piston of which is connected with the main beam, and the water from this pump first passes into the hot well *g*, and is thence pumped up by *h*, which conveys it back to the boiler through the pipe *i*. The cistern in which the condenser is, is supplied with cold water by the pipe *k*, connected with the beam, so as to bring up the water at every

Instruments, &c.

stroke of the engine, from a reservoir below. The valves for admitting and carrying off the steam are closed by levers worked by the engine through the means of the piston rods E F, connected with the pump *f*. The apparatus just described constitutes what is called the working geer of the engine, and though apparently complex, is necessary to keep the beam in motion. When it is required to stop the engine, this is effected by closing the steam valves, and thus preventing the admission of steam into the cylinder. The remaining apparatus, by which the other end of the beam is enabled to perform the work required, consists of a very large fly-wheel G, on the axis of which is fixed a concentric toothed wheel H, which works upon a similar wheel I below, in such a manner that two revolutions are made by the fly-wheel for one of the wheel I. To effect this, H and I are connected together at their axis by a bar of iron, while I is fastened to a rod that proceeds from the further end of the beam, as shewn in the figure. Thus, when the wheel I is raised by the beam, both moving on those at H, turn round the fly-wheel at the rate just mentioned.

The general operation of this machine will be understood from the connection of its several parts now described, and from what will be immediately mentioned respecting the movements of another engine; but it is proper to explain the mechanism by which the steam is made to act alternately on the opposite ends of the piston, and thus give motion to the beam. Supposing the piston to be raised, as in the figure, and the lower part of the cylinder to be filled with steam, to bring down the piston, the steam valve *a*, and eduction valve *d*, are opened by the handle E, when the steam escapes from the cylinder through *d* into the condenser, while fresh steam rushes in by *a*, and forces down the piston. When this is done, the steam valve *c*, and eduction valve *b*, are opened, the steam leaves the upper part of the cylinder by the latter, and fresh steam flows in below by the former, and forces *up* the piston. Thus the beam is alternately raised and depressed, and gives motion to all the parts of the apparatus that are connected with it, and in particular to the axis of the fly-wheel, by means of which the work required of the engine is performed.

The improvements made on this engine have been so numerous, even since the time when Watt introduced his valuable alterations, that it is difficult to give an intelligible description of them adapted to its present state. The following is derived chiefly from a respectable popular work lately published.

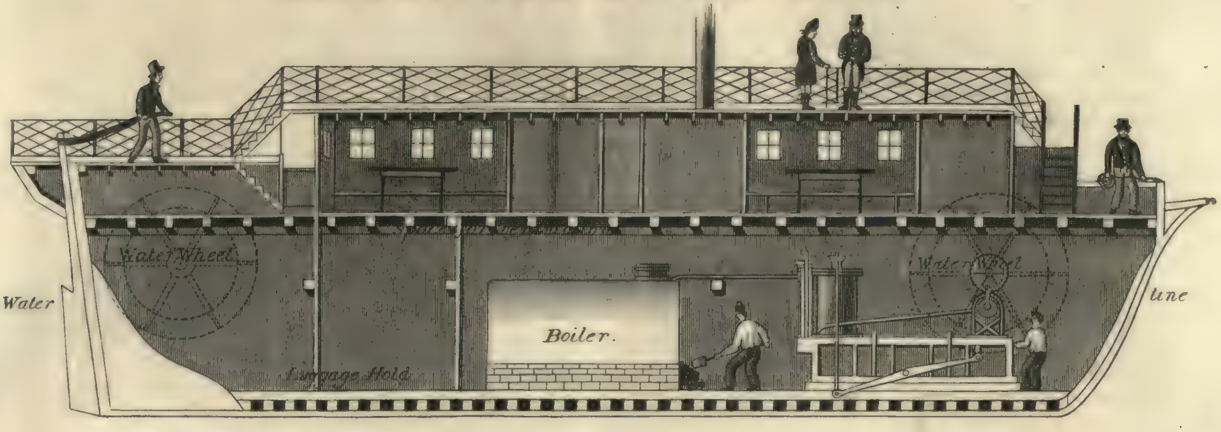
A, Fig. 1. Plate 154. is a boiler, with a wide bottom, and the sides contracted so as to allow the flame of the furnace to act on them with greater effect. As in similar engines, the boiler is of an oblong form, and the top takes off to admit of its being occasionally cleaned. It is furnished with a valve opening upwards, and called the *safety valve*, which is loaded at the top, to prevent the escape of the steam, till this fluid acquires so much elastic force as to endanger the bursting of the boiler. Sometimes there are two boilers, that one may be employed while the other is under repair or cleaning. B represents an apparatus for regulating the heat of the furnace. C is a tube called the steam-pipe, proceeding from the boiler to I, a valve connected with the top and bottom of the cylinder D, to receive the steam, and therefore sometimes called the steam-cylinder. In this cylinder works a piston, the rod of which, E, is connected with one end of a beam, the other end of which is connected by means of a crank with the heavy fly-wheel G, by which the power of the engine, when at work, is accumulated, and directed wherever required. On the axle of the fly-wheel, but eccentric to it, is a smaller wheel H, which, by its levers, gives motion to the valve I, which is so constructed as to be steam tight without the usual packing. K is a valve for admitting the steam into the cylinder, and is connected with a governor, which regulates the velocity of the apparatus. L is the cylinder of a pump, for discharging the water and uncondensed vapour from the condensor M. From this last vessel proceeds a pipe to the cistern N, containing water, and at the top of the pipe is a valve, called the blow valve, or shifting valve, for discharging the air from the cylinder D, and its connecting passages, before the engine is set in motion. P is a pipe called the eduction pipe, for conveying the steam from the valve I, to the condenser M. P is a pump which supplies with water the cistern S S, in which stand the discharging pump and condenser. Q Q are two of four iron pillars for supporting the beam and its accompaniments, and standing on an entire plate, seen edgeways in the figure that supports the principal parts of the engine. R R represents a recess below for containing the cistern of the discharging pump, condenser, &c. The engine now described is of what is called an eight-horse power, or is capable of performing as much work as could be effected by the strength of eight horses.

Instruments, &c.

To understand the action of the steam-engine, it must be observed, that, before it is set in motion, the cylinder and adjacent passages are filled with common air, which it is necessary to discharge before the steam is admitted. This is effected by a contrivance which opens the valves, so as to form a communication between the steam-pipe, the place below the piston, the eduction pipe, and the condenser. Only a little steam at first enters the cylinder from the resistance of the air; but the air in the eduction pipe and condenser is forcibly driven before the steam, and passes out through the valve and cistern. The steam-admission valve is then closed, and the admitted steam is condensed into water, partly by the coldness of the condenser, but chiefly by a jet of cold water, which enters it through a cock from the well in which the condenser stands. Thus a vacuum would be formed but for the expansion of the air in the cylinder filling all the vacant space; but by a repetition of the former process the air is gradually extracted, and the cylinder is filled with steam. The steam below the piston being condensed by the farther admission of it being cut off for the time, and by its communication with the condenser, the steam is admitted above the piston, and presses it down to the bottom of the cylinder, when the communication being opened between the upper part of the cylinder and condenser, the steam above the piston is condensed, and fresh steam admitted from below. By these alternate admissions and condensations of the steam, the piston is by turns raised and

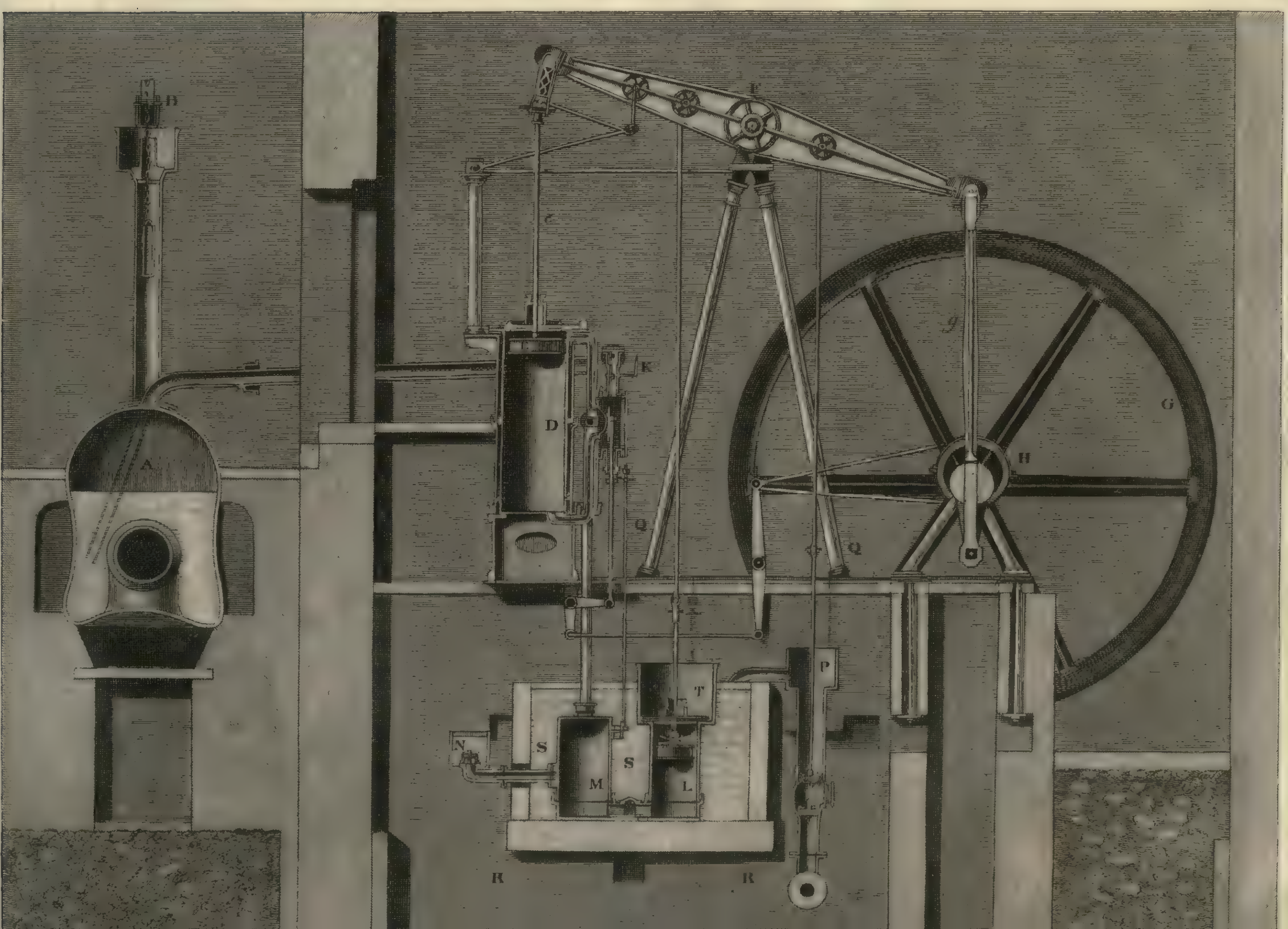
Fig 2.

## DALSWINTON STEAM BOAT.



## STEAM ENGINE.

Fig 1.



Instruments, &c.

depressed, and the beam connected with it is moved up and down, so as to give motion to the fly-wheel and the apparatus connected with it.

The power of the steam-engine depends on the size of its parts, and more especially on that of the piston, since the larger this part is made, the greater will be the pressure of the steam upon it. Supposing it to be 16 inches in diameter, it will be pressed by a force equal to about a ton and a half, making no allowance for friction; and allowing this, the pressure will be equal to about a ton.

The latest improvement in steam-engines which has yet appeared is that of Mr Perkins, consisting in substituting for the usual cylinder a very strong vessel of gun-metal, capable of heating the water to nearly double the usual boiling temperature, and thus increasing the elasticity and consequently the pressure of the steam, which is retained by valves, so loaded, that when it escapes it exerts an amazing force on the piston, with a proportionally less expense of fuel. The vessel is called a *generator*; and, besides the advantage of augmenting the power of the steam, is, from its great strength and elasticity, much less likely to burst than the ordinary boiler. See *Edinburgh Phil. Journal*, Vol. viii. Mr Perkins is now employed in perfecting the *steam-gun*, by which several bullets can be fired in a minute from the same piece.

*Steam vessels.*—The ordinary steam-vessels now in use have a steam engine, sometimes two, proportioned to the size of the vessel, fixed in a convenient part of the ship, so as not to interfere with the cabins or the hold, and from the furnace rises a tall vent for carrying off the smoke. Connected with the moving power of the engine are two water-wheels, which act as paddles for propelling the ship through the water. In the usual construction, these paddles are placed on opposite sides of the vessel, below the gunwales, and projecting beyond them. This construction is liable to several inconveniences. It occasions such a breadth in midships as renders it difficult for the steam-boat to get alongside of another vessel, and prevents it from entering the narrow passage of an ordinary dock, or navigating a narrow canal. From the paddles being placed near the centre, the vessel is apt to dip forward or astern, and requires to be trimmed in the opposite direction. To obviate these inconveniences, Mr Stevenson proposes to adopt the Dalswinton steam-boat, which is double, or has two keels, and to place the paddles one at the stem and the other at the stern. The motion of such a vessel would be equable and easy; but it would require two small steam-engines, one connected with each paddle, instead of the present large one. It would also, by making a difference of about 10 feet in the breadth of the vessel, enable it to pass through narrower openings than can be passed by the present steam-boats, and especially through the locks in most canals. A longitudinal section of a steam-boat, on Mr Stevenson's construction, is represented at Fig. 2, Pl. 154. and will be understood by inspection.

The great consumption of fuel in these vessels, amounting sometimes to ten tons daily, must always be a serious obstacle to their being used in long voyages; for though it is computed that, in such a vessel, a voyage to Calcutta might be completed in two months, it is evident that in this calculation no allowance is made for stormy weather, by which the ship might be driven considerably out of her course, and prevented from touching at ports where a supply of fuel could be procured; and if to this objection be added, the injury which the paddles must sustain from the beating of a tempestuous sea, the success of such a voyage is very uncertain, and must be a source of dreadful anxiety to the friends of those who undertake it.

The application of steam-engines to carriages, so as to enable them to move at a prodigious rate without horses, is not yet so complete and satisfactory as to admit of its being described in this treatise. The same remark applies to Mr Brown's gas-engine.

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Poetry.

POETRY. See LANGUAGE and VERSIFICATION.

Poisons.

POISONS.—The name *poison* is given to those substances which, in a small or moderate quantity, are capable, when applied to certain parts of the body, of producing death or exciting dangerous symptoms. The term, as applied to the greater number of deleterious substances, is relative, as many of them, in a certain quantity or dose, form valuable remedies, and become poisonous only when the dose is much increased; some, again, are deleterious to some individuals, while they are harmless to others, and some may be swallowed with impunity, but if applied to the lungs, or received directly into the circulation, they produce palsy, convulsions, or death. Again, many substances which, when pure and properly prepared, are found wholesome and nourishing, become hurtful when corrupted, adulterated, or improperly managed. According to some late writers, the number of domestic or *culinary* poisons is much greater than is generally supposed.—The avarice of traders, wine and spirit merchants, brewers, bakers, and other provision manufacturers, and the folly or ignorance of cooks, daily convert the most innocent and wholesome viands into vehicles of disease, and render such as are naturally less wholesome absolutely deleterious by their abominable mixtures. These considerations render the subject of *poisons* highly important, not only to individuals but to the community at large; and though the effects of several of the more active poisons, and the means of removing or counteracting them, have been described in the treatise on MEDICINE, it is proper to resume the subject here, for the purpose of giving a general view and arrangement of *poisons*, particularising those which are most dangerous, or have not before been noticed, and making a few practical remarks on the adulterations of food and the methods of detecting them.

Poisons differ in their effects, and the time in which these effects are produced, according to their nature, quantity, and the mode in which they are exhibited. They are conveniently divided into four principal heads; *mineral* poisons, such as arsenic, several preparations of mercury, and antimony, copper, lead, some earthy salts, and the fluid mineral acids;—*vegetable* poisons, as opium, hemlock, night-shade, laurel, and laburnum;—*animal* poisons, as phosphorus, and the secreted juices attached to the fangs of certain serpents and the stings of some insects;—and *gaseous* poisons, as hydrogen, carbonic acid, sulphurous acid, and some of their compounds, the effluvia of marshes, and contagion. The *mineral* poisons are, in general, the most active, though not the most speedy, in their effects, and some of them are poisonous in very small doses in a fluid state. They are usually received into the stomach, and produce their primary effects on the alimentary canal, exciting pain, heat, and other inflammatory symptoms; vomiting, purging, and afterwards debility, hiccup, fainting, cold sweats, and death, and the canal is found mortified or corroded. Similar effects, but less violent and speedy, and requiring a larger dose, are produced by absorption, when some of those substances are applied to the skin by washing or rubbing, while others affect chiefly the heart or the nervous system. The *vegetable* poisons, when swallowed, or simply applied to the skin, are, in general, much less speedy in their operation, and most of them require a larger dose than the former. Some of them, when applied to a recent wound or puncture, are extremely active, and produce almost instant death. Their principal effects are on the nervous system, and are shewn by giddiness, headache, tremors, convulsions, lethargy, apoplexy. The effects of *animal* poisons are so various that they cannot be reduced to general laws, but must be considered under their distinct heads. Most of the *gaseous* poisons act only when inhaled. Some of them are altogether irrespirable, and produce death by suffocation; others may be inspired for a time, but soon produce giddiness, headache, and apoplexy, and a few act by exciting inflammation or fever. Some of them act when merely applied to the skin, or introduced into the system by puncture.

The *medical treatment,* in cases of poison, may be reduced to three indications;—the removal of the poison from the body by emetics, or by an exhausting syringe furnished with a slender elastic tube, when it has been swallowed, or by cutting out the external part to which it has been recently applied,—destroying or counteracting its effects by the administration of *antidotes,* or such substances as decompose the poison, dilute it so as to render it less active, or defend the alimentary canal against its acrimony,—and obviating particular symptoms by appropriate remedies. The first method, where it can be adopted, is evidently the most effectual, and experience has shewn that, with the pipe and syringe, most of the contents of the stomach may be drawn off with little difficulty.

1. Mineral Poisons.—The most formidable of this class are the *metallic* poisons. It is probable that none of the metals in a pure and solid state are capable of acting as poisons, but some of them, especially *lead* and *copper,* are so easily oxidated or rusted, and in that state are so readily dissolved by the juices of the stomach, that they may be considered poisonous in any state when swallowed,—and hence a copper coin or leaden shot cannot be received into the stomach without danger. In the state of oxide, most metals are more or less poisonous; but they are still more dangerous when combined with acids so as to form a salt.

*Gold,* in the metallic state is perfectly innocent, but its muriate is poisonous in very small doses, even 1-4th of a grain; but as it is not likely to be used in this country, as in France, in medicine, it may be dismissed without farther notice.

*Silver.*—The nitrate of silver, or lunar caustic, now much employed as a remedy for epilepsy, is a corrosive poison, exciting inflammation in the alimentary canal, with thirst, a metallic taste in the mouth, a burning heat, and blueness of the lips. The best antidote is common salt dissolved in gruel or warm water, followed by plenty of mucilaginous drink, and bleeding and fomentations, if the inflammation be violent.

*Mercury.*—The vapour of mercury, inhaled during the process of gilding metals, and similar arts, produces tremors, salivation, ulcers of the mouth, spots on the skin, and if long continued, or often repeated, palsy, apoplexy, and death. Similar symptoms follow the imprudent or protracted use of the black oxide, in the form of pill or ointment, of calomel, and the other active preparations of that metal. They should be avoided, or discontinued, as soon as the first symptoms appear; and the more violent effects are counteracted by purgatives, the warm bath, the sulphuret of potash, and, if necessary, bleeding. But the most active mercurial poison is corrosive sublimate; the effects of which, and their treatment, have been described under Medicine, Part II. Chap. xii.

*Copper.*—The salts of copper are virulent poisons when taken into the stomach. The most common are the sulphate, or *blue vitriol,* and the subacetate, or verdigris. The effects of both are similar, and require the same treatment,—see Medicine. The use of copper vessels in domestic economy cannot be too much deprecated, as the tinning soon wears off, and then no precaution can prevent the metal rusting round the edges of the liquor they contain. It is a common practice with cooks to leave hams and other salted meats that are to be eaten cold, to soak for some hours in the liquor in which they were boiled. If the boiler be copper, nothing can be more senseless, except the still more abominable practice of boiling a halfpenny with vegetables or pickles, to make them retain their green colour. We may here remark, that oysters and mussels, collected in docks or harbours, frequented by copper-bottomed ships, are poisonous, from their liquor being impregnated with copper. The presence of copper is detected by adding hartshorn, or *ammonia,* to the suspected substance, which produces with copper a blue colour.

*Lead.*—All the compounds of lead are poisonous, especially the white oxide or *white lead,* the red oxide or *red lead,* and the acetate or *sugar of lead.* Both the oxides are frequent causes of disease to colour-makers and painters; and the red, in the form of red wafers, has often proved fatal to birds, and dangerous to children. The principal effects of lead on the human system, and the best methods of counteracting them, are related under Medicine.

White wines, gin, and water long kept in leaden cisterns, are often impregnated with lead, which is added to the first to correct its acidity, and to the second to give it transparency and a fine straw colour. It is therefore a desirable object to detect such impregnation. The best method of doing this, in white wine, is to pass through the wine, in a clear glass vessel, a stream of *sulphuretted hydrogen* gas, which produces a dark turbid cloud in wine so adulterated. The simplest process for employing this test is to provide a clean Florence flask, fitted with a cork through which passes one end of a bent glass tube, so as to be air tight, while the other end of the tube may be introduced into the wine; then putting into the flask some pieces of sulphuret of antimony about the size of a pea, having over them muriatic acid, and applying the heat of a lamp or a hot poker, gas will be extricated, and, passing through the tube into the wine, will, if lead be present there, give the dark appearance just described. The same test will detect lead in spirits and in water; but in these limpid liquors it is more convenient to use a solution of Glauber's salt or sulphate of soda, which, if lead be present in the liquor, will produce a white cloud, which soon falls to the bottom of the vessel, and is sulphate of lead.

*Zinc.*—The sulphate of zinc, or white vitriol, though a valuable remedy in several cases, and particularly as an emetic, is, when taken in too large a dose, and retained in the stomach, deleterious, and in many cases a poison, though in a less degree than several other metallic salts. It produces the usual metallic taste in the mouth, straitness in the throat, anxiety and difficulty of breathing, vomiting and purging, with their accompaniments, faintness and coldness of the extremities. When it proves fatal, the alimentary canal is found inflamed. The treatment consists in plentiful dilution with warm milk or gruel, or even warm water, with the usual remedies against inflammation, if it appear violent.

*Antimony.*—The only preparation of this metal which is likely to prove poisonous is emetic-tartar, given in too large a dose, or to very young and debilitated subjects; and even a moderate dose, when long retained in the stomach, may, in such persons, excite many alarming symptoms, as violent and incessant vomiting and retching, cramps in the stomach, purging, spasms of the muscles, and fainting. Plenty of warm water should be given to dilute the poison and assist its evacuation, and then a decoction of Peruvian bark, with a little laudanum, the former to decompose the salt, and the latter to relieve cramp and promote perspiration. If vomiting should not take place, the throat must be tickled to excite it, and the bark must be given without the laudanum. When vomiting cannot be produced, recourse must be had to the pipe and syringe.

*Arsenic* is the most poisonous of all metals; even its vapours, which are occasionally inhaled in some of the arts, and are perceived by having a garlic odour, cannot long be breathed with impunity, as they produce tremors, wasting of the muscles of the arms, and palsy. The sulphurets, called *orpiment* and *realgar*, are very noxious; but its most dangerous form is that of the arsenious acid, or *white arsenic*, the effects of which, with the proper treatment, are sufficiently explained under MEDICINE.

*Bismuth.*—The subnitrated or *white oxide* of bismuth, lately introduced into medicine as a remedy for cramp in the stomach, and sometimes used as a white paint for the face, requires caution in its management, as it is apt to produce dangerous derangement of the alimentary canal, followed by giddiness and coma. The best remedies are plentiful dilutions with warm milk or gruel, and the warm bath.

*Mineral Acids.*—The mineral acids most likely to act as poisons are the sulphuric, the nitric, and the muriatic; the first two of which have been noticed under MEDICINE, and the last differs so little in its effects and their treatment that it is unnecessary to particularise either. To this head might be added oxymuriatic and sulphurous acids; but as they are usually applied in the form of *gas*, they are considered under the fourth class; while prussic acid, though produced artificially like the mineral acids, is properly a vegetable poison.

The *caustic alkalies* of potash and soda, when taken into the stomach, act, like the acids, by irritating and inflaming the alimentary canal. The best antidotes are vinegar and the juice of lemons, diluted with gruel or barley-water. *Quicklime* is a substance of a similar nature, and requires a similar treatment, except that, in this case, weak sulphuric acid is the best antidote, unless water strongly impregnated with carbonic acid can be easily procured.

Of the *earthy salts* the *barytic* are the most deleterious, but they are not likely to be employed as poisons. When such cases occur, they are best treated by exciting vomiting, and then giving Epsom salts to decompose the remaining poison, and carry it off by the bowels. *Muriate of lime* may prove poisonous, and is counteracted by carbonate of soda, with plentiful dilution.

*Nitre* and the *oxymuriate of potash*, are the only alkaline salts that can usually prove poisonous. The first of them is noticed under MEDICINE, and the effects of the other are so similar, and require so much the same treatment, that it is unnecessary to do more than mention it.

2. VEGETABLE POISONS.—The number of vegetable substances which may act as poisons is very great, and among them are many which, properly managed, prove excellent medicines, and others which either nearly resemble some wholesome articles of food, or are nefariously used as adulterations of them.

The *narcotic* poisons and some others belong to the first division, and include alcohol, opium, henbane, wild lettuce, nightshade, and the prussic acid, with the vegetables that contain it. The effects of alcohol and opium, and the methods of relieving or counteracting them, are sufficiently explained under MEDICINE, and the prussic acid is the only other poison of this division, the particular effects of which it is necessary to mention. The general effects of the narcotic poisons, when taken into the stomach, or applied to an abraded part of the body are stupor, numbness, heaviness of the head, a desire to sleep, at first slight, but soon growing insuperable, giddiness, intoxication, dilatation of the pupils, a wild or lively delirium, convulsive motions of the muscles, palsy of the legs, variable pulse, coma, and death. The treatment in such cases resembles that detailed under *Narcotismus* in the treatise on MEDICINE.

*Prussic*, or *Hydrocyanic Acid*, which has lately been introduced into medicine as a remedy in consumptive cases, is, in an over-dose, one of the most virulent poisons. It forms a component principle of many vegetables, especially the laurel, the distilled water, extract, and oil of which speedily destroy animal life; the leaves and kernels of the peach and nectarine, and bitter almonds,—and the liquors called Noyau and Ratafia derive from it their peculiar and dangerous flavour. Its first effects are pain, irritation, increased secretion of urine, purging and spasmodic action of the muscles; but these are soon changed into symptoms of an opposite nature, convulsions, palsy, coma, and death. Its action is most speedy when applied immediately to the nerves. The best antidote is *ammonia*, when the poison has been received externally; but if it has been swallowed, vomiting must first be excited, after which the patient should take a cup of strong coffee, with three or four drops of oil of turpentine every half-hour.

Another division of the vegetable poisons consists of those called irritating or acrid, many of which are also used in medicine. The principal are aconite, briony, colchicum, bitter-apple, elaterium, white and black hellebore, gamboge, *rhus toxicodendron*, and squill. The effects of these substances, when given in a quantity sufficient to prove poisonous, are generally the following: an acrid, pungent, bitter taste, heat and dryness in the mouth, a painful constriction of the throat, sickness, vomiting, purging, constant retching, pain in the stomach and bowels, acceleration of the pulse and breathing, great weakness, fainting, and sometimes death. The treatment in these cases is often difficult; but the safest plan is to give plenty of barley-water, linseed tea, or other mucilaginous drink, till the most of the poison is expelled, and then small quantities of strong coffee, by way of clyster, if rejected by the stomach, with now and then three or four grains of camphor mixed with yolk of egg, and applying anodyne fomentations to the belly. When the more formidable symptoms are subdued, the strength of the patient must be supported with beef-tea or barley-broth.

A third division of vegetable poisons consists of the *narcotico-acrid*, comprehending, among others, poisonous mushrooms, *nux vomica*, belladonna, stramonium, foxglove, and tobacco. The effects of these poisons differ considerably in the several species, but only the first and last are here noticed, as they are most likely to come under observation. The *toadstool*, and several other species of *agaricus*, are occasionally eaten by mistake for common mushrooms, and produce several deleterious effects, as sickness, vomiting, and purging, heat and pain in the stomach and bowels, spasms, convulsive twitches, intolerable thirst, and a small hard frequent pulse, sometimes delirium and coma. The treatment consists in clearing the stomach and bowels, by emetics of epicacuanha, or emetic tartar and castor oil, and afterwards supporting the strength of the patient by cordials. *Tobacco*, in the form of smoke or snuff, produces, in those who are not accustomed to it, very unpleasant, and sometimes dangerous effects, as severe sickness and vomiting, very like what take place in sea sickness, purging, giddiness, a kind of stupid intoxication, followed by faintness and lethargy. These effects are most remarkable when the poison has been received into the stomach, but they may occur when the tobacco is applied to an abraded part of the body, as when a person takes a large pinch of snuff, where the nostrils are excoriated. Slight affections of this kind are often relieved by a draught of cold water. If they be severe, the expulsion of the poison should be promoted, by drinking copiously weak warm tea, with sugar, but without milk, while the patient is freely exposed to the open air, and his face and breast bathed with cold vinegar and water. If coma take place it will be proper to bleed, especially from the jugular vein, and afterwards give strong coffee, using the other means directed for the treatment of *Narcotismus* under MEDICINE. It is a good rule, even for experienced snuff-takers, to take none before breakfast or after supper.

*Deleterious Vegetable Food.—Flour* may prove deleterious, or at least unwholesome, from being made of damaged or fermented corn, or corn mixed with the seeds of *darnel*, a narcotic weed that infests corn fields, or from being adulterated with clay or plaster. It is not easy to detect these admixtures, but the second is discovered by its narcotic effects, and the first by the damaged flour forming sweet puddings or bread. This quality is corrected by carbonate of magnesia. *Bread* is often *manufactured* with a mixture of alum, to make it white, firm, and porous, and if the alum be in small quantity we do not believe that it will produce any other effect than rendering the bread dry and harsh when stale; but if the proportion be too large, the bread will be sour, and will disorder the stomach and bowels. A decoction of such bread will produce a white precipitate on adding to it muriate of barytes. Magnesia is the best antidote.

*Malt Liquors.*—Though the statute allows nothing but malt and hops in the brewing of these liquors, it can scarcely be doubted, and indeed is acknowledged by Morrice and other practical writers on the art, that many other ingredients enter into their composition; as *quassia*, to save hops; grains of paradise, coriander, and carraway, to increase the pungency of the liquors; burnt sugar, molasses, and Spanish liquorice, to heighten the colour, and *cocculus Indicus* to give porter a peculiar rich flavour, and increase its intoxicating quality. In spite of the grave nonsense which Accum and others have written on this subject, we venture to affirm, that all these substances are innocent except the last, and that, with this exception, the statute is too severe. The kernel of the cocculus Indicus possesses properties similar to those of the narcotico-acrid poisons, and in any considerable quantity must be highly deleterious. It is almost impossible to detect its presence, though it may be suspected when the liquor has a heavy taste, and when a small quantity of it affects the head much. New or very sweet ale generally affects the bowels, from the quantity of undecomposed sugar, and should be avoided by delicate or sedentary persons. For the methods of judging of genuine ale and porter, see BREWING.

*Counterfeit Tea.*—The infusion of genuine *tea*, especially *green* tea, when made very strong, prove deleterious to many persons, producing a gnawing pain at the stomach, and tremor of the limbs. See DIETETICS. The adulteration of tea with leaves of other trees and plants, especially those of the *sloe*, the *ash*, the *white thorn*, and probably the *wood sage*, is very common. That all these substitutes are more or less injurious, by spoiling the flavour of the tea, and some of them by imparting to it a disagreeable astringency, is undoubted; but whether those just mentioned have any *dangerous* properties is very questionable; and if counterfeit tea be poisonous, it must be rendered so by mixtures with which we are not acquainted. It is very easy for an experienced botanist to detect these frauds, by selecting from the leaves, after infusion, such as are pretty entire, and comparing them together as to shape and colour. The leaves of the true tea are rather long, sharply pointed at the tip, and deeply jagged or serrated, and when infused acquire a pale brownish-green colour. All leaves which do not answer this description are counterfeit; and all that can be said more is, that the shops where such adulterated tea is purchased should in future be avoided.

*Counterfeit Pepper.*—It is well known that *ground* pepper is very commonly adulterated, either by mixing with it Jamaica pepper, or what is called *pepper dust*, marked in druggists' catalogues P. D. that is, the refuse and sweepings of warehouses, where large quantities of pepper are ground. It is certainly very provoking thus to be cheated in the flavour or strength of a favourite spice, and the P. D. may sometimes be deleterious. It may be supposed that this vexation may be avoided by grinding one's own pepper; but unluckily, even *whole* pepper is often adulterated with oil-cake, clay, and Cayenne pepper, formed into a mass, and granulated through a wire sieve. This fraud is detected by putting some of the suspected pepper into a bowl of water, stirring it round, and allowing it to remain some time, when the genuine pepper will remain entire, while the counterfeit will crumble down to the bottom of the vessel.

3. ANIMAL POISONS.—Some of these poisons are irritating and inflammatory; as phosphorus, cantharides, and ammonia. Pure *phosphorus*, when taken into the stomach, as it has sometimes been taken by way of stimulant, excites great heat, and, if the quantity exceed a small portion of a grain, inflammation. Such cases are uncommon, and, when they occur, are best treated with emetics, and mucilaginous liquors containing nitre. *Cantharides* are now scarcely ventured on as an internal stimulus, except in the form of tincture, under medical advice; for in an over-doze they are highly inflammatory, and produce great irritation in the alimentary canal and urinary organs. Copious dilution with mucilaginous liquors impregnated with camphor is the best remedy, and the same treatment is useful in strangury and other unpleasant effects following the application of blisters. When liquid *ammonia* or hartshorn has been taken in large quantity, the best antidote is gruel sweetened with sugar, and acidulated with vinegar or lemon juice. Inhaling much of the vapour of ammonia has sometimes excited inflammation of the lungs. If this be early observed, it may be obviated by inhaling the steam of hot vinegar and water; if not, it must be treated as directed for *Pneumonia* under MEDICINE.

*Deleterious Animal Food.*—Many species of fish and other marine animals, are poisonous, but fortunately they are not likely to be eaten in this country; but several British species may become deleterious from feeding on poisonous matters, as when fish in ponds and lakes are caught in consequence of being stupified or killed with *cocculus Indicus*. How *mussels* may become poisonous has been already stated; but these animals, in their best state, cannot be eaten by some persons without producing unpleasant and even alarming symptoms, swelling of the body succeeded by eruptions, pain in the belly, vomiting, purging, and torpor; but the eruption is a favourable symptom. The best treatment is to clear the stomach and bowels, use the warm bath, and take vinegar. *Putrid animal food* is always unwholesome, and when taken in large quantity or long continued is very deleterious, producing sickness, purging, and fever, or carbuncles, purple spots and scurvy. Emetics, in the first instance, followed by vinegar, or rather *pyroligneous acid*, the use of fresh raw vegetables and port wine, are the most likely means to give relief. Putrid eggs are most dangerous, and have sometimes occasioned death. *Cheese* of a high colour is often poisonous, from the annato with which it has been tinged having been adulterated with red lead. High coloured cheese should always be examined, by putting it into water impregnated with sulphureted hydrogen with a small quantity of muriatic acid, when, if the cheese contain lead, it will assume a dark brown or black colour.

*Animal poisons received by wounds.*—The bites of venomous serpents, especially the *cobra de capello*, the *rattlesnake*, and the *viper*, are highly dangerous, and those of the two first often fatal. The symptoms are detailed under OPHIOLOGY, and the treatment is given under MEDICINE. The best antidote is pure or caustic ammonia, given internally as well as applied to the wound. The dreadful effects of the bite of *rabid animals*, especially the mad dog, and the treatment most likely to be successful, are described under *Hydrophobia*, in the treatise on MEDICINE.

The *gaseous poisons* are very numerous, and are derived from all the three kingdoms of nature, but the mineral and the animal are the most dangerous.

The *mineral gaseous poisons* comprehend the noxious gasses; some of which, as *carbonic acid* and *azotic* gases, act by substituting an irrespirable air for that which is necessary to life, and thus producing *asphyxia*, suffocation. See *Asphyxia* under MEDICINE. Others, as *hydrogen gas* and its compounds, and *nitrous oxide*, or gaseous oxide of azote, produce effects similar to those of the narcotic poisons, succeeded by suffocation if their action be continued. The treatment is therefore such as is suited to *narcotismus asphyxia*, according as the symptoms of either prevail. Many of these gases, as those of the volatile mineral acids, especially the *sulphureous, nitrous, muriatic, oxymuriatic*, to which may be added pure oxygen gas, are irritating to the windpipe and lungs, and excite inflammatory symptoms, which are to be combated in the usual way, after inhaling the steams of warm water and hartshorn, to neutralise and dilute the irritating vapours.

*Marsh effluvia*, or *miasma*, seem to form the only deleterious vegetable gaseous poison. Its effects are fully described, and the proper treatment is explained, in MEDICINE, under *Intermittent Fever*.

The effluvia of putrid animal matters prove deletereous in several ways. In a state but little concentrated, they excite sickness and purging, as is often experienced by anatomical students on first attending a dissecting room; but when much accumulated and confined, they give rise to fever, and are probably one exciting cause of typhus, and, as some think, of the plague. Their effects are best prevented by free ventilation and acid fumigations.

*Contagion*.—That the effluvia of living animal bodies, labouring under certain diseases, are capable, under certain circumstances, of producing the same diseases in healthy persons exposed to them, is almost universally allowed; though medical writers are not agreed as to the number of diseases which can thus be produced. The febrile eruptions, as *small-pox, measles*, and *scarlet fever*, are most generally acknowledged to be of this description, and to them must be added *hooping-cough*. With respect to *typhus* and the plague, see MEDICINE and PLAGUE. The question is still disputed, though most believe them to be communicable by the same means as the former. Such diseased animal effluvia are classed together under the generic name *contagion*, or they are said to form the *matter of contagion*, and the diseases which they are capable of producing are denominated *contagious*. The precise nature of contagion has not been ascertained; but assuming it to be a material substance, we shall here describe its properties and laws of action, so far as they are known, and point out the best means of preventing its effects.

Contagion is not an object of the senses, though some persons have imagined that they perceived an unusual smell at the time they probably caught a contagious disease. It is so dense as to adhere to the diseased body, and communicate the disease by contact, at least in the febrile eruptions, and yet it is so subtile as to be readily diffused through the air surrounding the body, and even conveyed to some distance. But, like all other poisons, contagion is most dangerous when most concentrated; and when the quantity of air in which it is diffused is considerable in proportion to the contagious effluvia, the effect is diminished till it is reduced to nothing. But where a contagious disease rages epidemically and attacks great numbers, even the general atmosphere becomes contaminated, and imparts its noxious properties to all who breathe it, and who are not insusceptible of the contagion. This is supposed to be the case with plague and typhus contagion, and the contagion of hooping-cough is also capable of impregnating a great volume of air. The contagions of small-pox, measles, and scarlet fever are less widely diffusible, and therefore more easily avoided. Contagion also attaches itself to the clothes and bedding of the sick, and even to the clothes of those healthy persons who remain long in the infected and confined atmosphere of the sick chamber, and may thus be communicated to others and conveyed to a distance. Wool and fur are the most likely to become the vehicles of contagion. A moist warm atmosphere is most favourable to the reception and propagation of contagion, and extremes of heat and cold, especially when accompanied with drought, destroy or diminish its effects. From the above remarks, it appears that all the contagions here mentioned may be communicated to persons predisposed to them, in two ways, by contact and by inhalation, that is, through the medium of the skin and the lungs. Some contagions, as those of small-pox, cow-pox, chicken-pox, and some say plague, may be communicated also in a third way, by inoculation. The *specific* or particular contagions differ from each other in one important circumstance. Some of them, as small-pox, cow-pox, chicken-pox, measles, hooping-cough, and probably scarlet fever, are capable of attacking the same individual only once in his life, or if, as sometimes happens, a second attack should take place, it is slight, and generally without danger; but the contagions of typhus and plague may attack the same person any number of times, and at least the first may at length prove fatal. The effects of these poisons, the circumstances which dispose persons to be affected by them, and the treatment of patients so affected, have been described under MEDICINE and PLAGUE; and it remains only to shew how their influence may be prevented or counteracted. The prevention of plague has been fully considered under that head.

*Preventions*.—We know of no means of preventing the contagion of hooping-cough except removal from the place where it rages, or confinement to the house where it has not made its appearance; and as this to children is often worse than the disease, it is scarcely advisable except in the country; in all the other contagions, removing the sick to a distance, or, in all except plague, to a remote apartment, and preventing all intercourse, direct or indirect, between them and the healthy part of the family, by assigning to the sick careful and distinct nurses and attendants. The apartments not infected must be freely ventilated, and both they and the passages leading to the chamber of the sick should be occasionally fumigated with the steams of strong vinegar, or the latter, when empty, with the volatile mineral acids, especially oxymuriatic, which seems to have the property of decomposing or destroying the matter of contagion.

To employ this acid for fumigating houses, ships, &c. two parts of common salt and one of black oxide of manganese are put into an open glass or unglazed earthen vessel, and three parts, by weight, of strong sulpuric acid (*oil of vitriol*) are added, and mixed with a glass rod at the moment of beginning the fumigation. The windows, port-holes, or other openings must be carefully closed, and the materials suffered to remain thus shut up for several hours before admitting the external air. Strict attention to domestic and personal cleanliness, avoiding permanent moisture, temperance, and the use of wholesome and nourishing food, with a moderate quantity of wine, cheerful recreation, and regular exercise, constitute the other rational means of preventing contagion.

The term *infection* has very commonly been confounded with *contagion*; but differs from it as being an effect and not a cause of disease, and in having no material existence. When the air is impregnated with contagion, it is said to be *infected*; and in the same way we speak of infected persons, clothes, goods, and houses. Again, certain diseases, as *syphilis* and the *itch*, are not contagious, though they are propagated by contact, because they cannot be conveyed through the air, but they are very infectious.

The principal works on poisons are, Mead's *Essay on Poisons*; Fontana *Sur les Poisons*, or the translation by Skinner; Fothergill's *Cautions respecting Lead and Copper*; Wilmer *On Poisonous Vegetables;* Orfila *Toxicologie Generale*, and *Secours a donner aux Empoisonnées*, or the translations; and Accum *On Adulterations of Food and Culinary Poisons.* See also PLAGUE, and QUARANTINE.

POITIERS, a town of France, and the capital of the department of Vienne, occupies a large space within its walls, on a rising ground near the river Clair; much of which space, however, is taken up with gardens. Before the revolution, it was the see of a bishop, and the residence of the governor of Pictou. Its chief manufactures are woollen caps, stockings, leather, and gloves, and the population is about 21,000. The literary institutions of this place are, a sort of university, a royal college, a provincial school, an atheneum, a public library, and a botanic garden. There are here several Roman antiquities, among which are some arches of an aqueduct, the ruins of an amphitheatre, and portions of a triumphal arch. Near this place, in 1356, Edward the Black Prince gained a victory over the French, taking prisoners King John and his son Philip, whom he carried to England.

POLAND, a dismembered kingdom of Europe, lies between the 47 and the 58 degree of north latitude, and the 14 and the 33 degree of east longitude, having the Baltic and Russia on the north, Russia on the east, Moldavia and Hungary on the south, and Germany and Prussia on the west; and containing upwards of 160,000 geographical square miles. This wide surface is divided into a great number of states, provinces, and dukedoms, many of which have already been or shall be described hereafter, in their proper place.

*General aspect.*—This is a flat country, striking out into extensive plains, diversified, however, by gentle undulations, but seldom by hills, except on the borders of Hungary, where there are mountains covered with wood. Large districts may be traversed without meeting with a single human habitation, and left entirely destitute of culture. In some places, especially towards the east, there are many marshes, lakes, and rivers. Small patches of cultivated land are occasionally met with on the borders of small lakes embosomed in pine woods from six to fifteen miles in extent; and in many places, particularly on the banks of the Vistula, there are rich and extensive pastures.

*Rivers.*—This country is watered by many large rivers, among which are the Dwina, which rises in Russia and flows northward through the upper part of Lithuania, and falls into the gulf of Riga; the Memel, which has a north-west direction, seeking Curische-haff, into which it falls; the Vistula, whose sources are in the Carpathian mountains, and its course of 450 miles, through the western parts of the kingdom, towards the Baltic, which it reaches at Dantzick; the Dniester, which descends from the Carpathian mountains, divides Poland from Moldavia, and falls into the Euxine sea; the Bog, which flows through Podolia, and falls also into the Euxine; and the Dnieper, which receives the Prypee above Kiow, and thence flows onward to the Black sea.

*Climate and Productions.*—Like most countries of Europe the climate of Poland varies much in different seasons. Spring is the pleasantest time of the year; the continental situation, together with the sandy soil of the country, causes a greater heat in summer than is experienced in any part of Great Britain. Winter is long and cold, the thermometer being often more than twenty degrees below the freezing point, and then the whole face of the country is covered with snow. Rainy winters, or rain and frost alternately, are most dreaded. The country is on the whole healthy. In the mountains are mines of lead, copper, iron, quicksilver, vitriol, and many other useful minerals. At Bochnia and Wieltska, south of Cracow, are extensive salt mines. The country abounds also in various kinds of clays fit for pipes and earthen ware. Corn, hemp, wood, and cattle, are raised abundantly on the surface. The country is generally uninclosed, and a Polish farm consists often of several thousand acres.

*Population, manners, &c.*—Since the dismemberment of Poland, the population has greatly declined. Previous to that event, it was regarded as amounting to nearly ten millions; by some writers, indeed, it was estimated as high as sixteen millions, but this was always considered as an exaggerated statement. The natives are divided into nobles, citizens, and peasants. The nobility, including the gentry, are handsome, open, generous, and brave; they are fond of display, having rich apparel, numerous retinues, and splendid equipages. They cut the hair of their heads short, and shave their beards, but reserve large whiskers. Their vest, with sleeves, is commonly of pink, yellow, or blue silk, over which is a loose tunic of cloth, velvet, or silk, which reaches a little below the knees, and is confined about the waist by a silk sash. The trowsers are of cloth or silk, and the tunic is edged with fur. They wear a fur cap, and have neither stock nor neckcloth. Their boots are made of turkey leather, and on horseback they are covered with a short clock, sometimes lined with fur. The ladies are sprightly, accomplished, and affable. Most of them use rouge, except very young girls. Many of them have adopted the French and English mode of dressing; but in winter they have recourse to a large silk pelisse, lined with wool, and edged with fur peculiar to the country.

The peasantry have a sullen dejected aspect. They are entirely subject to their masters, as in feudal times. This abject state of bondage makes them indolent, indigent, and reckless of the future. In summer they wear a coarse shirt, loose drawers, and a small fur cap, without shoes or stockings. In winter they have a coarse, reddish, woolen garment lined with sheepskins, and their feet and legs are covered with heavy buskins. A woman's dress is a variety of different colours, tawdry, and unbecoming.

The palaces of the nobility have an extensive front, consisting of a central mansion flanked by wings. But the furniture is scanty, the rooms have no carpets, the beds are generally without curtains, and the tables and chairs destitute of ornament. Every stranger on a journey carries his own bedding along with him. The houses of the peasants are mean huts, of a round form, open at top, covered with thatch or boards, and have commonly one apartment only, in which the people and their cattle lodge together. Their diet is a scanty allowance of milk, poor cheese, and coarse bread. Twelve o'clock is the dinner hour of farmers, two that of the higher orders.

The villages of the country are for the most part situated on the skirts of a large forest, and consist of a collection of wooden huts, covered with straw or turf. Many of the smaller towns are also constructed chiefly of wood; but the more considerable towns are built of brick, and often stand in the vicinity of a morass. The manufactures of the country are trifling, consisting of the coarse fabrics worn by the peasants, with some earthen ware. The retail trade is mostly in the hands of the Jews. The imports are wine, spices, hardware, silk, velvet, with many other articles. The exports are grain, flax, hemp, linseed, wax, honey, horses, cattle, timber, and other products of the country, chiefly in a rough unwrought state.

*Religion and Literature.*—The established religion of the country is Roman Catholic, but Protestants and the Greek church are tolerated. The Jews are indulged with great privileges. Monasteries are numerous, and the monks and clergy are said to be illiterate and profligate. The principal universities of Poland are those of Cracow, Wilna, and Posen. The first of these has eleven colleges. The directors are all priests, and the course of study is chiefly theological. This seminary was founded and endowed by Casimir the Great. The children of the nobility are in general educated in their own houses; but this order, who plume themselves on their privileges, are apt to treat learning and science with contempt. The lower orders are extremely ignorant and superstitious. There are some original writers in the Polish language, but there have been more in Latin, and translations from the learned and modern languages are common.

*History.*—The Poles are the descendants of the Lazi, a Sarmatian nation, who migrated from Colchis on the east side of the Euxine sea. This origin is indicated by their modern designation; for Polazi, in their own language, signifies the children of the Lazi,—a term which, being corrupted into Lechi, might give rise to the tradition that the name of their first leader was Lech. The form of government, as was to be expected, was unsettled, and was frequently changed from one form to that of another. Lech and his posterity are said to have held the supreme power, under the title of Dukes, during the space of 200 years. But this is the dark period of fable and uncertainty. The Lechian family was succeeded by twelve Woywoods, who established an aristocratical form of government, and who oppressed the people to a degree which provoked them to resist their authority; and their opposition having been crowned with success, they invested Cracus with the supreme command. This prince and his descendants continued in power till the beginning of the ninth century, when the country was again involved in the calamities of a civil war; and in 842 succeeded an obscure citizen of the name of Piastus. From this man the dukes of Poland were called Piastes; but nothing worthy of notice has been recorded of his descendants or successors during the space of a hundred and fifty years. Boleslaus, surnamed the Intrepid, who obtained the supreme power about the beginning of the eleventh century, is the first sovereign of Poland who assumed the name of king. Casimir III. who resigned Silesia to John of Luxembourg, and Pomerania to the Teutonic knights, gave a code of laws to Poland, and founded an university at Cracow.

In the year 1384, Uladislaus V. Duke of Lithuania, ascended the throne of Poland, the first of the third dynasty of its sovereign princes. This race continued to enjoy the throne till 1572, when it ended by the demise of Sigismund Augustus, and then the monarchy became elective. Henry de Valois was the first of the elected kings of Poland, and he was advanced to this dignity in 1573. He granted his people religious liberty, and many civil immunities and privileges, and then retired to France after the death of his brother Charles IX. He was succeeded by Stephen Batori, prince of Transylvania, who bravely defended his kingdom against the Turks and Tartars. In 1587 Sigismund III. son of John III. king of Sweden, was raised to the throne, and reigned till 1632. He was succeeded by his son Uladislaus IV. during whose reign the Cosacks revolted. His brother, John Casimir, reigned after him, and was unsuccessful in that war against the Swedes which terminated in 1600 by the peace of Oliva. In his days the elector of Brandenburg obtained the sovereignty of Eastern Prussia, which was afterwards erected into a kingdom. The reigns of several princes from this period were distinguished by nothing remarkable. Augustus II. in 1704, was forced to resign his throne to Stanislaus Lescinski, but recovered it after the battle of Pultowa; he acceded to the treaty of Vienna in 1726, and died in 1733. Stanislaus Lescinski again appeared as a candidate for the vacant throne, and was actually elected by a majority of the nobles; but the rest of the electors, protected by a Russian army, chose Augustus, son of the last king; and his election was ratified by the peace of Vienna in 1738, and he reigned till 1763. In the following year, the Empress of Russia, in concert with the courts of France, Prussia, and Austria, placed Stanislaus Augustus Poniatowski upon the throne, who was the last king of Poland. Foreign influence had long before this excited and cherished dissensions among the nobles, by which the horrors of civil war were produced; and at length the King of Prussia, the Empress of Russia, and the Empress of Austria, entered into an alliance to dismember Poland, and to divide its separate portions among themselves. This plan was formed in 1772, and accomplished in the course of the following year.

Austria took possession of Little Poland, which lies between the Vistula and the Gropack mountains, with the whole of Red Russia and Procutia,—territories which comprehend the royal salt mines of Wieliezks and Bochnia. Russia appropriated Polish Livonia, the north-east division of Lithuania, beyond the Dwina—all of which lay contigudus to the regions included in that great empire. Prussia obtained the western division of Pomerania, and, with the exception of the cities of Dantzick and Thorn, the whole of Polish Prussia. The king of Poland had no power to resist this spoliation of his kingdom, and was induced to submit to it the more quietly, by being left in possession of a rich territory, rendered, by the guarantee of the spoilers, hereditary in his family.

In 1791, a revolution took place in Poland, and a new constitution, formed out of those of England and America, was produced, and approved by the king, the nobility, and the people. But the interference of the foreign powers soon overturned this new order of things, and fairly blotted out this devoted country from the list of the kingdoms of Europe. The King of Prussia added the city of Dantzick to what he had already seized upon; and the Russian ambassador ordered that the new form of government should be abolished, that all papers relative to the transaction of 1788 and 1791 should be given up, and that the military establishment of the country should be reduced. The Poles made some shew of resistance, but were speedily overpowered; and, in 1795, a final and complete division of the kingdom took place. At that time, the Prussian borders were extended, so as to include Warsaw, Pleske, Gnesna, Prava, and Pesna. The territories seized upon by Austria contained the cities of Cracow, Lamberg, and Lublin; and in those which came under the sway of Russia, were the towns of Wilna, Grodno, Bresc, Nowogrodeck, Kaminiech, and Braclaw. At the treaty of Tilsit, Buonaparte formed an independent state, called the Dutchy of Warsaw, out of the provinces ceded to Prussia. This dutchy contained a population of 2,160,000. The Emperor of Russia now assumes the title of the King of Poland.

POLAR EXPEDITIONS.—Of the attempts that have been made to discover a north-western passage into the Pacific, we have already given a brief notice in the order of the alphabet. (See NORTH-WEST PASSAGE.) But as the polar regions, from many concurrent circumstances, present a field for research of more than ordinary interest, we here resume the subject. Under this title, we shall give an account, as ample as our limits will permit, of the principal polar voyages, not excepting the new discoveries in lower latitudes, and also notice the most interesting particulars connected with the manners and customs of the natives of these regions.

On various interesting facts respecting the practicability of sailing directly north to the pole, have been founded some ingenious speculations. In several tracts published by the Honourable Daines Barrington, he expresses his decided conviction of the practicability of sailing due north to the Pole; and, moreover, instances various navigators who have reached very high northern latitudes, some of whom, it has been asserted, even reached the pole. One Mr Watt declared to our author, that, in the 17th year of his age, he made his first voyage with Captain M'Callam, on board a Scotch whale-ship; that the captain resolved to make an attempt to reach the north pole, and accordingly proceeded to 83½°, when the sea was not only open to the northward, but no ice had been seen for the last three degrees; that while he still persisted in advancing, the mate complained of the compass not being steady; which circumstance obliged him, though with reluctance, to abandon the enterprize. Mr Barrington was informed by Dr Campbell, the continuator of Harris's voyages, that Dr Dallie, a Hollander, being in his youth on board a Dutch ship of war, which, at that time, was usually sent to superintend the Greenland fishery, the captain formed the resolution to endeavour, during the interval between the first and second fisheries, to reach the pole, and succeeded in penetrating as far as 88°, when the weather was warm, the sea free from ice, and rolling like the bay of Biscay; and that Dallie pressed the captain still to proceed, who replied, he had already proceeded too far, and should be blamed on his return for neglecting his station; upon which he allowed no journal to be kept, and with all possible dispatch returned to Spitzbergen. In the year 1662-3, Mr Oldenburgh, then secretary of the Royal society, was ordered to register a paper, entitled, *Several Inquiries concerning Greenland, answered by Mr Gray*, who had visited these parts. To one of these queries, namely, How near hath any one been known to reach the pole? The reply is, "I once met upon the coast of Greenland a Hollander, that swore he had been half a degree from the pole, shewing me his journal, which was also attested by his mate, where they had seen no ice, but all water." The following notice of a Dutch ship which reached the latitude of 89°, is given in Captain Wood's account of a voyage in search of the north-east passage. "Captain Goulden, who had made above thirty voyages to Greenland, did relate to his Majesty, that being at Greenland some twenty years ago, he was in company with two Hollanders to the east of Edge's island; and that the whales not appearing on the shore, the Hollanders were determined to go farther northward; and in a fortnight's time returned, and gave it out that they had sailed into the lat. of 89°, and that they did not meet with any ice but a free and open sea, and that there run a very hollow grown sea like that of the bay of Biscay. Mr Goulden being not satisfied with the bare relation, they produced him four journals out of the two ships which testified the same, and that they all agreed within four minutes." The following passage is contained in the *Phil. Trans.* for 1675. "It is well known to all that sail northward, that most of the northern coasts are frozen up for many leagues, though in the open sea it is not; no, nor under the pole itself, unless by accident." The having reached the pole is in the same passage alluded to as a familiar fact, and stated as such to the Royal society. Notwithstanding the vague and questionable manner in which these narratives, the authenticity of which cannot perhaps be satisfactorily proved,—are stated there may be some truth in them. But we must patiently wait the result of future researches in the same quarter before presuming to come to any decision.

The remark has been often made, that by the discovery of an open navigation across the polar basin, the passage over the pole, or close to it, will be a peculiarly interesting event to science; and the problem with which the learners of geography are often puzzled, namely, that of going the shortest way between two places, lying east and west of each other, by taking a direction of north and south, will be practically solved.

It is necessary that the navigator bestow his undivided attention to the passage of the pole; for, on approaching this point, from which the northern coasts of Europe, Asia, and America, and every part of them, will bear south of him, he can be directed in determining his course, and keeping on the right meridian of his destined place, only by a knowledge of the time, though no means will be afforded him of ascertaining that time. While he remains on or near the pole, the only time he can have, with any degree of certainty, must be that of Greenwich, which he can know only from good chronometers. He cannot obtain an approximation even of the apparent time by observation, owing to the hazy state of the atmosphere, particularly about the horizon, and the sameness in the altitude of the sun at every hour in the four-and-twenty, and he will have no stars to assist him. Indeed, his ideas as to the heavens and the reckoning of his time will be reversed, and the change not gradual, as in proceeding from the east to the west, or *vice versa*, but instantaneous; and the magnetic needle will point to its unknown magnetic pole, or fly round from the point of the bowl in which it is suspended, consequently that which indicated north will now be south, the east will become west, and the hour of noon will be that of midnight.

The result of the late expeditions does not lead us to an absolute conviction that an open navigation across the polar basin will ever be effected; and time only can shew how far perseverance in the attainment of objects connected with science in general, and particularly that of navigation, may in the end be successful. But as the expeditions that have been undertaken for the discovery of a north-west passage have been the means of extending the sphere of human knowledge, they certainly cannot be said to have been sent out in vain.

Since the extension of geographical knowledge, both the polar regions have been the object of eager curiosity; but the English have had a more intimate and profitable connection with the northern than with the opposite extremity of the globe. When the grand discoveries of Vasco De Gama, and Christoval Colon first attracted the attention of commercial adventurers, it was suggested that shorter routes might be found to the regions of wealth by pursuing a northerly navigation, and three questions consequently presented themselves for solution. Was the communication practicable by the north-east, or by the north-west; or might there not be a possibility of at once traversing the polar sea? It has been ascertained that the north-easterly communication is of no use for commercial purposes,—because such are the impediments, that a vessel could not possibly complete the navigation (supposing it indeed fairly practicable) in a shorter time than five or six years. The attempts of the different nations of Europe, however, to obtain here a shorter route to the Pacific, have had a happy result, by opening two advantageous channels for commerce, the Spitzbergen fishery and the Archangel trade.

In all probability the first arctic discoveries were made by the Scandinavians, who by their roving expeditions became acquainted with the coasts of Greenland, and of the main North American continent. Settlements were established on the former of these regions, but some of them perished in wars with the natives, and a dark veil was thrown over the history of the fate of the colonies of East Greenland, by the visitation which interposed an impenetrable mass of ice between them and the open ocean. The expedition in 1380 of the brothers Nicolo and Antonio Zeno, who were Venetians of noble race, was perhaps the earliest voyage made in this direction from more southerly ports. It is supposed, that in the fifteenth century, previously to his famous expedition, Columbus had visited Iceland, and sailed to some distance within the polar circle; and in 1497 Newfoundland was first discovered by Sebastian Cabot, a distinguished navigator, who is supposed to have been a native of Bristol, where his father, a Venetian, had settled as a merchant and pilot, under the patronage of Henry VII.

By the enterprizes of the English under Cabot, of the Portuguese under the Cortereals, and of the French under the command of Aubert, the Spaniards were stimulated to exertion. Estevan Gomez, in his voyage, reached some portion of the northern extremity of America, and carried off a few of the natives.

Among the attempts made by the English in the same course of navigation during the early part of the sixteenth century, occurred the expedition of Sir Hugh Willoughby, which was fitted out with the most sanguine prospects of success. The object of this unfortunate navigator was to try the north-eastern route to Cathaia, for which purpose Sebastian Cabot drew up instructions for him. But notwithstanding every precaution for the success of this celebrated expedition, it entirely failed. On the coast of Lapland two of the ships were frozen up, and Sir Hugh Willoughby with about seventy persons perished from the rigour of the climate,—a catastrophe which the author of the Seasons pathetically describes in the following lines:

——————" Miserable they!
Who, here entangled in the gathering ice,
Take their last look of the descending sun;
While full of death, and fierce with tenfold frost,
The long long night incumbent o'er their heads,
Falls horrible. Such was the Briton's fate,
As with first prow, (what have not Britons dar'd!)
He for the passage sought, attempted since

So much, in vain, and seeming to be shut
By jealous nature with eternal bars.
In these fell regions, in *Arzina* caught,
And to the stony deep his idle ship
Immediate seal'd, he with his hapless crew,
Each full exerted at his several task,
Froze into statues; to the cordage glued
The sailor, and the pilot to the helm.

For the recovery of the ancient Greenland colonies several expeditions were dispatched from Denmark about the middle of the 16th century. In the year 1578 Frederick II. sent out Magnus Heinson, who, after encountering many dangers, obtained sight of the east coast of Greenland, but had not fortitude to approach. He became alarmed, after proceeding some time, with a fair wind, towards the coast, without appearing to get any nearer; a circumstance which, on his return home, he attributed to his ship having been checked in its course by means of loadstone rocks in the sea; but of which the real cause, perhaps, was the deceptive character of the land as to distance. Under the auspices of Queen Elizabeth, three voyages were about the same time made by Martin Frobisher towards the north-west. Frobisher discovered Meta Incognita, a strait called by his name, and some other places of little importance; but it cannot be ascertained, from the accounts of his voyages, whether these lands and inlets were on the coast of Greenland, or on that of Labrador. The unfortunate expedition of Sir Humphrey Gilbert, who was a man of great talent and intrepidity, took place in the year 1583. The voyages of Davis, though they did not prove advantageous to his employers, tended very much to promote hydrographic knowledge. Shortly after the enterprizes of Davis, the voyage of Maldonado, and the discovery of the strait of Anian, leading from the coast of Labrador to the great ocean, took place. Barentz's voyages are remarkable for the discovery of Spitzbergen; and for the disasters by which the crew were obliged to winter on the coast of Nova Zembla, and to navigate, in open boats, the Frozen ocean, through a space of eleven hundred miles. The attempts of Henry Hudson, though ineffectual in deciding the object for which they were undertaken, contributed much to the mass of scientific acquisition. His first enterprize was for the purpose of attempting the direct course towards the pole; his second was entered on for the discovery of the north-eastern passage. In his third voyage he discovered the river that bears his own name; and, in his last, undertaken in the year 1610, he entered Hudson's strait and bay. See the article HUDSON.

Baffin's enterprizes hold a respectable rank among the expeditions which distinguish the early part of the 17th century. The accounts of his voyages, however, are so defective, that until the late surveys of Captains Ross and Parry, the character and limits of the bay that is known by his name were not defined with any degree of accuracy.

During the 18th century a number of discoveries were made; and the navigators, Moor, Smith, Phipps, Cook, Kotzebue, and others, are celebrated for their zeal and ability, though they had not the merit of making any positive approximation to the solution of the grand problem. A new impulse was given to the general curiosity by the land journies of Hearne and Mackenzie to the northern extremity of America. These travellers, by succeeding, on different parallels, in reaching what appeared to be the sea, added an important link to the series of deductions which had given rise to the hypothesis of a north-western passage.

In the year 1818 the British government fitted out two expeditions; one of which was destined to proceed directly north between Greenland and Spitzbergen; and the other, under the immediate command of Captain Ross, to explore the passage up Davis' straits, and the trending of the American coast. Little advantage resulted from the exertions of Captain Ross, whose assertion, that he had proved the existence of a bay from Disco to Cumberland strait, and set at rest for ever the question of a north-west passage in this direction, proved very dissatisfactory to individuals who possessed the best means of investigation. The failure of this expedition seems attributable either to defective observation, or to some other censurable cause. We may, however, briefly notice the contents of Captain Ross's work. On May 3, 1818, the Isabella and Alexander sailed from the Shetland islands; and, after encountering the usual difficulties and hazards of the northern seas, the ships were, on the 6th August, beset and nearly wrecked by the pressure of the ice. In describing this scene, Captain Ross says, "It became a trial of strength between the ship and the ice; every support threatened to give way; the beams in the hold began to bend, and the iron tanks settled together. At this critical moment, when it seemed impossible for the ship to sustain the accumulating pressure much longer, she rose several feet, while the ice, which was more than six feet thick, broke against her sides, curling back on itself. The great stress now fell upon her bow; and after being again lifted up she was carried with great violence towards the Alexander, which ship had hitherto been, in a great measure, defended by the Isabella. Every effort to avoid their getting foul of each other failed; the ice, anchors, and cables broke one after another, and the sterns of the two ships came so violently into contact, as to crush to pieces a boat that could not be removed in time. The collision was tremendous, the anchors and chain plates being broken, and nothing less expected than the loss of the masts; but at this eventful instant, by the interposition of Providence, the force of the ice seemed exhausted; the two fields suddenly receded, and we passed the Alexander with comparatively little damage. The last things that hooked each other were the two bower anchors, which being torn from the bows, remained suspended in a line between the two ships, until that of the Alexander gave way."

The crews of the vessels afterwards communicated with some of the natives, who were astonished at the sight of Europeans and ships, which, to them, was altogether new. In these interviews, an Esquimaux, named Sacheuse, who had been brought to England by a Greenland ship, acted as interpreter, in which respect his services were of essential use. The natives of Prince Regent's bay he recognised as the aborigines of his country, exclaiming, "These are right Esquimaux; these are our fathers." Captain Ross represents, that from the accuracy of the examination of the northernmost part of Baffin's bay, the continuity of it may be positively inferred; an opinion in which the officers of both ships are said to have agreed. Mr Fisher, in his published journal, seems, however, to think that the point was very questionable, and makes the following guarded but pertinent observations: "We made sail to the southward, and abandoned the search for a passage in this quarter, from a thorough conviction, I should hope, that not any such passage exists here. I am perfectly satisfied myself, that this is not the place to look for it, although I must confess that I did not see the continuity of land all around the top of this bay, if it may be so termed; and in order to shew that I am not the only person who has been unfortunate in this respect, I have inserted in the appendix, No. 6. an exact copy of the ship's log for this day, by which it does not appear that the land was seen all around at one time; neither by a comparison of the bearings of the east land and of the west, taken at different times, do they appear to meet." The failure at Lancaster's sound is an unfortunate event in Captain Ross's voyage. It appears very unaccountable, that a point so important as the continuity of the land at the bottom of this inlet, should be with confidence asserted and laid down in the chart with such an air of precision. But the falsehood of these inferences was demonstrated in a subsequent expedition, and it was ascertained that, in all probability, Lancaster's sound is a branch of the ocean which separates North America from the polar regions.

As the issue of Captain Ross's voyage gave satisfaction neither to the country nor the admiralty, a second expedition was determined on, to be entrusted to the sole care of Lieutenant Parry, who was allowed to make choice of his own officers and men. This enterprising navigator had been commander of the Alexander, the second ship under the orders of Captain Ross in the Isabella. In May 1819, Lieutenant Parry sailed from the Nore, with the Hecla, bomb, of 400 tons, and the Griper, of much smaller dimensions, both of which vessels were strengthened by transverse beams and additional planking. To the crew double pay was assigned, and for their health and comfort every precaution was taken. In the narrow part of Davis' strait the ice was found remarkably troublesome, and in one instance the ships were five hours crossing a stream of ice, the width of which did not exceed three hundred yards. Of the distressing nature of polar navigation, some idea may be formed from the account given by Mr Parry. "About three A. M." says he, "by a sudden motion of the ice, we succeeded in getting the Hecla out of her confined situation, and ran her up astern of the Griper. The clear water had made so much to the westward, that a narrow neck of ice was all that was now interposed between the ships and a large open space in that quarter. Both ships' companies were therefore ordered upon the ice to saw off the neck, when the floes suddenly opened sufficiently to allow the Griper to push through under all sail. No time was lost to attempt to get the Hecla through after her, but by one of those accidents to which the navigation is liable, and which renders it so precarious and uncertain, a piece of loose ice which lay between the ships was drawn after the Griper by the eddy produced by her motion, and completely blocked the narrow passage through which we were about to follow. Before we could remove this obstruction, by hauling it back out of the channel, the floes were again pressed together, wedging it firmly and immoveably betwixt them: the saws were immediately set to work, and used with great effect; but it was not till eleven o'clock that we succeded, after seven hours labour, in getting the Hecla into the lanes of clear water which opened more and more to the westward."

After a hazardous navigation through a vast body of ice, without any indication of a clear sea beyond it, the Hecla and Griper made Lancaster's sound by the close of July, which was one month earlier than the period at which that inlet had been reached in the former year, and yet Captain Parry set out a fortnight later. Thus were exemplified the advantages of local knowledge, added to accurate calculations and skilful manœuvres. On obtaining the first sight of the southern point, the Hecla telegraphed the Griper. The two ships entered the opening under crowded sails, and as they approached the critical line that was to confirm their apprehensions or their hopes, the crews were anxiously on the look out in all directions. "It is," says the captain, "more easy to imagine than to describe the almost breathless anxiety which was now visible in every countenance, while, as the breeze increased to a fresh gale, we ran quickly up the sound. The mast-heads were crowded by the officers and men during the whole forenoon, and an unconcerned observer, if any could have been unconcerned on such an occasion, would have been amused by the eagerness with which the various reports from the crow's nest were received, all, however, hitherto favourable to our most sanguine hopes."

When the vessels reached the supposed closure of the gulph, they sailed over the visionary barrier; and thus was set at rest an important point, namely, that of the continuity of the land at the bottom of Lancaster's sound. It was ascertained, in a word, that the inlet so called was not properly a sound, but formed a connection with the polar sea. As their progress was checked by the ice on the 5th August, it was determined to take a southerly course, by which they were brought within the capes of a large inlet, down which they sailed till the 8th of the same month, when a compact line of ice, stretching from shore to shore, stopped their progress. This large strait, which has received the name of Prince Regent's Inlet, branches off from the main channel, and is supposed to communicate with some of the unexplored indentations of Hudson's bay. The ships now sailed to the northward, and, in a higher latitude than that in which their previous attempts had been made, obtained on the 20th a passage to the westward. The opening, hitherto denominated Lancaster's sound, being so far ascertained to be a capacious channel, now received the name of Barrow's straits. Captain Parry and his associates were animated with enthusiasm by means of their success, as appears from the following extract: "Though two-thirds of the month of August had now elapsed, I had every reason to be satisfied with the progress which we had hitherto made. I calculated upon the sea being still navigable for six weeks to come, and probably more, if the state of the ice would permit us to edge away to the southward in our progress westerly: our prospects indeed were truly exhilarating; the ships had suffered no injury, we had plenty of provisions, crews in high health and spirits, a sea, if not open, at least navigable; and a zealous and unanimous determination, in both officers and men, to accomplish, by all possible means, the grand object on which we had the happiness to be employed." The movements of the compasses had, from the period of entering Barrow's straits, become irregular and languid, and magnetic energy entirely ceased in Regent's inlet. The directive power of the needle becoming altogether subservient to the attraction of the vessel, the ships in the course of their navigation crossed the northward of the magnetic pole, and passed over one of those spots on the globe where the north pole of the needle would have pointed due south. Captain Parry observes that this spot would, in all probability, at this time, be somewhere not far from the meridian of 100° west of Greenwich. Continuing to advance to the westward, the vessels, on the evening of the 4th September, passed the meridian of 110 degrees west longitude, which entitled Captain Parry and his crew to L.5000, being the first bounty in the scale of rewards proposed by the order in council to adventurers in this quarter. Although beset with appalling difficulties, Captain Parry and his associates pursued their course till forward movements became impracticable, and they were compelled to look out for a place of shelter for the winter. The Griper was driven on shore by the ice, about the 20th of September, and her commander, Lieutenant Liddon, was rendered almost incapable for duty from a severe attack of rheumatism; yet when urged to allow himself to be removed on board the Hecla until his vessel should be afloat again, he absolutely refused to do so, asserting he should be the last person to leave the ship. This intrepid officer accordingly remained at his post, and during the greater part of the day he continued seated against the lee side of the deck, giving the necessary orders. The following description of the ships, two days before the Griper was forced on shore by the ice, shews what hazards and difficulties had been previously encountered. "From noon until six o'clock in the evening, we were favoured with a fine breeze from the southward and westward, so that we got back a considerable distance; but no sooner had the wind become light than our progress was stopped by the bay-ice, notwithstanding every effort was made to force through by breaking it up with capstan bars, blocks of wood, and by rolling a boat amongst it under the ship's bows. At the very time that our progress was thus arrested, the necessity of getting on became more evident than ever, for a large floe was observed to be moving to the westward with considerable velocity, and at the same time closing in with the land, from which we were not distant above a quarter of a mile. Our situation was, therefore, a very precarious one indeed; but as it was impossible to avoid the danger that threatened us, we let go an anchor in ten fathoms of water, after being driven within less than a cable's length of the shore. Here we waited with great anxiety the approach of the floe, for although we were driven towards the shore by it, we were not actually in contact with the floe itself, but were carried along with the bay-ice that it impelled towards the land. Close to where we anchored, there happened, very fortunately for us, to be a large hummock, or rather a pile of heavy pieces of ice aground, so that when the floe arrived this pile received the shock of it; and the collision was certainly tremendous,—for immense masses of the floe were broken off, and piled up on the top of what was already aground, from which most of them fell, or slided back again on the floe; and this operation continued for some time, until at length the force of the floe, which was at first going at the rate of two miles per hour, was almost entirely spent. It is unnecessary to observe that, had the ships been caught between the floe and the hummock just mentioned, their destruction would have been inevitable."

It was now found necessary to return to a convenient harbour, which was at length found in Lat. 74°, 47′, 15″, Long. 110°, 48′, 30″, west, where they were laid up for the winter. Every preparation was made in order that the first opportunity might be seized of getting out of Winter harbour, where they were detained ten months. While the ships were on the homeward voyage the western coast of Baffin's bay was closely surveyed. On their return home they had to encounter a severe storm, which caused the Hecla to carry away her bowsprit, fore-mast, and main top-mast.

This expedition, though it did not discover a communication with the Pacific, yet ascertained that the existence of a north-west passage was extremely probable. Indeed, Captain Parry did not despair of the north-west passage into the Pacific ocean; and, with a view to easier access, he proposed the exploration of Cumberland strait, Roe's welcome, and Repulse bay, as probable communications with the polar sea.

About the period of which we have been treating, the Russians, under the command of Otto Von Kotzebue, undertook a voyage of discovery into the South sea and Behring's straits, in pursuit of a north-east passage, in which much curious information was collected. Several new islands were discovered in the south seas by this navigator, who also ascertained the true position of more belonging to the same archipelago, and made us acquainted with the manners and customs of the islanders.

Captain Scoresby's journals of two voyages to the whale fishery, afford considerable information on the polar navigation. He proposed, in the former of these voyages, to include the survey of the whole of the circumference of the arctic regions, excepting Iceland and Greenland, which divisions had obtained the notice of Mr Henderson, Sir George Mackenzie, and Professor Giesecké. His descriptions of such tracts as fell under his observation are remarkably interesting, being accompanied with anecdotes and illustrations supplied from his own experience and the information of others. "Spitzbergen and its islands," he observes, "with some other countries within the arctic circle, exhibit a kind of scenery which is altogether novel. The principal objects which strike the eye are innumerable mountainous peaks, ridges, precipices, or needles, rising immediately out of the sea, to an elevation of 3000 or 4000 feet, the colour of which, at a moderate distance, appears to be blackish, shades of brown, green, grey, and purple; snow or ice in striae, or patches, occupying the various clefts and hollows on the sides of the hills, copping some of the mountain summits, and filling with extended beds the most considerable valleys; and ice of the glacier form occurring at intervals, all along the coast, in particular situations, as already described, in prodigious accumulations. The glistening or vitreous appearance of the iceberg precipices, the purity, whiteness, and beauty of the sloping expanse formed by their snowy surfaces; the gloomy shade presented by the adjoining or intermixed mountains and rocks, perpetually covered with a mourning veil of black lichens, with the sudden transitions into a robe of purest white, where patches or beds of snow occur,—present a variety and extent of contrast altogether peculiar; which, when enlightened by the occasional ethereal brilliancy of the polar sky, and harmonized in its serenity with the calmness, constitute a picture both novel and magnificent. There is indeed a kind of majesty not to be conveyed in words in the extraordinary accumulations of snow and ice in the valleys, and in the rocks above rocks, and peaks above peaks, in the mountain groups seen rising above the ordinary elevation of the clouds, and terminating occasionally in crests of everlasting snow, especially when you approach the shore under shelter of the impenetrable density of a summer fog; in which case the fog sometimes disperses like the drawing of a curtain, when the contrast of light and shade heightened by a cloudless atmosphere, and powerful sun, burst on the senses in a brilliant exhibition resembling the production of magic." This bleak and inhospitable climate has a summer day of four months continuance without a setting sun, counteracted by a winter night of equal duration partially broken by a dim twilight, and often enlivened by the aurora of the northern hemisphere. Notwithstanding the unfavourable climate of this region, however, parties have sometimes actually remained in it during the winter, in order to procure a supply of furs and skins against the return of their vessels in the open sea; a seclusion in which not a few have perished from privation, dejection, and disease.

In his hydrographic survey of the Greenland sea, Mr. Scoresby has given an interesting collection of experiments, notices, and calculations concerning the various marine phenomena. With the view of shewing the direction and influence of the currents, he quotes the following statement, which affords a striking picture of the casualties to which navigators are exposed in these high latitudes. "From a narrative of the loss of several of the Dutch Greenland fleet in the year 1777, we learn that the ship Wilhelmina was moored to a field of ice on the 22d of June, in the usual fishing station, along with a large fleet of other whalers. On the 25th, the ice having rapidly closed around, the Wilhelmina was closely beset. The pressure of the ice was so great, that the crew were under the necessity of working almost incessantly for eight days in sawing a dock in the field, wherein the ship was at that time preserved. On the 25th of July the ice slacked, and the ship was towed by the boats to the eastward. After four days laborious rowing they reached the extremity of the opening, where they joined four ships, all of which were again beset by the ice. Shortly afterwards they were drifted within sight of the coast of Old Greenland, about the parallel of 75½° north. On the 15th of August nine sail were collected together; and about the 20th, after sustaining a dreadful storm, and being subjected to an immense pressure of the ice, which accumulated them 20 or 30 feet high, two of the ships were wrecked. Two more were wrecked four or five days afterwards, together with two others at a distance from them. On the 24th, Iceland was in sight. Some of the ice was in motion, and two ships seemed to escape. Another was lost on the 7th September, and on the 13th the Wilhelmina was crushed to pieces by the fall of an enormous mass of ice, which was so unexpected that those of the crew who were in bed had scarcely time to escape on the ice half naked as they were. One ship now alone remained, to which the crews of four, and the surviving crew of a fifth (that was wrecked on the 30th of September) repaired. By the beginning of October, they had drifted to the latitude of 64°, and on the 11th the ship was overwhelmed by the ice and sunk. More than three hundred men were by this event exposed on the ice, in a most deplorable condition, of whom two hundred perished, while about one hundred found their way to the Danish settlements on the western shore of Greenland.

Some valuable researches on the eastern coast of West or Lost Greenland, are included in the accounts of the second voyage of Captain Scoresby.

In 1822 this navigator sailed north as far as 80.30. or within 570 miles of the pole, and on April 28. his vessel was checked in its progress by the main northern ice, which appeared an impassable mass standing to the north-west and south-east. They entered the main western ice in the month of March, and afterwards discovered land extending from north by east by the compass to north-west; the nearest supposed to be at the distance of fifty miles. This unlooked for land was the eastern coast of Greenland, being a continuation towards the north of that coast on which in the tenth century the Icelandic colonies were planted. Captain Scoresby looked on it with intense interest, and flattered himself with the hope of being able to land upon some of its picturesque crags, where European foot had never trod, before the season for the fishery should come to a close. As no ship had ever before penetrated, he had reason to believe, within sight of this coast at so early a period of the summer, he was encouraged to expect that his wishes would not be difficult to accomplish; and as the main design of his voyage was fortunately compatible with researches about this unknown region, he determined immediately to penetrate towards the shore. He accordingly exerted himself in making a survey of the whole coast near which he sailed; and that he might insure all possible accuracy, he carefully ascertained the variation in the ship's course occasioned by the local attraction of the compass. Observations were taken by him from a compass placed in the crow's nest of one of the vessels, where there was no iron near enough to affect it, by a comparison of which with observations taken from the binnacle compass, the true course of the ship was ascertained. These surveys were unavoidably interrupted by the prevalence of foggy weather, during which however some curious observations were made on the phenomena of atmospheric refractions,—for the detail of which we must here refer the reader to Captain Scoresby's work; (see also METEOROLOGY, in this Encyclopædia.)

Our navigator, after sailing a considerable distance, and taking a particular survey of the coast, had at length the happiness of visiting it; an occurrence of which he gives the following account: "Being anxious to land upon a coast on which no navigator (a whale-fisher or two perhaps excepted) had ever set foot, I thought this a favourable opportunity for gratifying my curiosity. This curiosity was heightened almost to the utmost pitch by the historical recollections of the Icelandic colonies that had at a remote period been planted a few degrees to the southward upon that same line of coast, and particularly by the hope, which I could not avoid indulging, that I might be able to discover some traces of those hardy people, the fate of whom for near four centuries has been a problem of such intense and almost universal interest. An additional interest attached to the investigation of this country, (if the interest excited by the above considerations were capable of augmentation,) was the circumstance of the singular and total failure of the many attempts of the Danes to reach this coast for the recovery of the ancient colonies, together with the peculiar enjoyment that necessarily arose out of the conviction that the shore on which I designed to land was entirely unknown to Europeans, and totally unexplored. As we stood in, I obtained several series of bearings of headlands, &c. with altitudes of the sun for the longitude, designed for the extension of my survey. Finding the coast bold, we reached within three quarters of a mile of the beach, where we had soundings in 25 fathoms. The weather being then extremely fine, and highly favourable for my purpose, I landed on a rocky point, named Cape Lister after a reverend friend. The coast here having changed its mountainous character, and become more level towards the south and west, we were enabled to reach the top of the cliff, which was only 300 or 400 feet high, and to travel along its brow to the westward. Sending the boat along shore, I traced the hill towards the west for three or four miles, passing over a continued surface of loose stones, or over beds of ice and snow, and then descended near cape Swainson, towards the beach, consisting here of a strip of flat strand, about a furlong in breadth. Here the first interesting object was discovered, consisting of a circle of stones, so artificially placed that there could be no doubt but it was the work of man, and soon afterwards other appearances of manual arrangement were met with. These were the remains of habitations, consisting of two circular walls, or, in some places, merely of rows of stones, enclosing a clear area of about five yards in diameter, laid out exactly in the manner in which the Esquimaux prepare the ground for their summer huts. Besides these there were several hollow tumuli, neatly arched in the form of a bee-hive, with an opening either at the top or on one side. These resembled the stores wherein the Esquimaux are known to deposit the produce of their fishing or hunting, when too considerable for present use. They varied in size, from two and a half to four and a half feet interior diameter. The principal part of these remains occurred on the west side of Cape Swainson, where also some other still more striking evidences of recent inhabitation were found. These consisted of two cavities, inclosed by stones, on the edge of a bank, that had been employed as fire-places, and in which were the remains of the fuel that had been used in them, consisting of charred driftwood, with half-burnt moss, and a quantity of ashes. The latter being of so light a nature as to be liable to be carried away by the melting of snow about them, impressed me with the opinion that they had not been here during the preceding winter, but that the persons who used these simple contrivances for fire-places must have been on the spot even in the present summer. As there were no permanent residences to be found, this place appeared to have been either resorted to as a summer fishing station by some of the natives, or touched at in their excursions along the coast. In addition to these evidences of the present existence of inhabitants, we met with several pieces of bone and wood which had undergone artificial fabrication; and also the head of an arrow, or small dart, rather neatly made of bone, armed with a small piece of iron. It is difficult to say whether this iron was native, or whether it was carried on shore in the timbers of some wreck. The manufacture was a good deal similar to that of the iron implements of the Arctic highlanders discovered by Captain Ross, and it is not improbable that it had a similar origin. The state and situation in which it was found indicated that it had not been long out of use. It was found lying in a little cavity of the rock where we first landed, in a pool of sea-water, yet it was not generally corroded by rust; on the contrary, it was so little acted upon that it did not seem to have lain many months. No other object of interest was observed, excepting some horns of rein-deer, and the bones of these or other animals; most of the bones were found about the site of the tents and huts, or in the tumuli adjoining. On my return to the ship, about 11 o'clock, the night was beautifully fine, and the air quite mild, The atmosphere, in consequence of the warmth, being in a highly refractive state, a great many curious appearances were presented by the land and icebergs. The most extraordinary effect of this state of the atmosphere, however, was the distinct inverted image of a ship in the clear sky, over the middle of the large bay or inlet before-mentioned, the ship itself being entirely beyond the horizon. Appearances of this kind I have before noticed, but the peculiarities of this were the perfection of the image, and the great distance of the vessel that it represented. It was so extremely well defined, that when examined with a telescope by Dolland, I could distinguish every sail, the general rig of the ship, and its particular character; insomuch that I confidently pronounced it to be my father's ship the Fame, which it afterwards proved to be; though, on comparing notes with my father, I found that our relative position at the time gave our distance from one another very nearly 30 miles, being about 17 miles beyond the horizon, and some leagues beyond the limits of direct vision. I was so struck with the peculiarity of the circumstance, that I mentioned it to the officer of the watch, stating my full conviction that the Fame was then cruizing in the neighbouring inlet."

Nothing extraordinary occurred after this till the morning of the 26th of July, when they landed near Cape Stewart, on a low, sandy beach, about a mile from a range of cliffs called Neill's cliffs after Mr Patrick Neill; which spot Captain Scoresby describes as by far the most interesting one he visited, both as regards its mineralogical, botanical, and other natural products, and its Esquimaux remains. Our limits will not allow of following Captain Scoresby through his examination of this spot; but, in justice to him, we must quote his account of an excursion upon the land named by him Traill island. "After an unsuccessful attempt to ascend," says he, "I entered upon a slope included between two precipitory rocks, and, with much labour, accomplished about 500 feet, above which the cliff rising vertically prevented further progress in that direction; but after skirting the brow of another precipice below me, where the inclination was at least 50°, and the surface entirely composed of loose sharp stones, I reached the bottom of a chasm between two prodigious pinnacles, and again proceeded upward. This attempt, which I was induced to undertake for the purpose of collecting specimens of the rocks and plants, eventually assumed such a hazardous aspect, that I would gladly have relinquished it could I have conveniently returned. The rocks of the pinnacles bounding the chasm, distant about 20 feet from each other, were verticle on both sides. One of these rocks, which was greatly decomposed and broken, so as to afford by no means a firm hold, I was obliged to grasp with my left hand, and to thrust my right hand among the loose stones, while every step was accomplished, and it frequently required considerable deliberation before a second step could be accomplished. A slip of the foot here might have been fatal, as the bottom of the chasm opened on a precipice of 400 or 500 feet, over which, whenever I moved, a large shower of the loose stones about me was immediately precipitated. At the top I expected to find at least some portion of flat surface that I hoped would repay me, by its productions, for the hazardous exploit into which my anxiety for specimens of minerals, plants, and animals had unexpectedly betrayed me; but, to my surprise, the top proved to be a ridge, (with the sea on both sides) narrower and sharper than the top of the highest pitched roof. Here I rested for a few minutes seated on the ridge, with a leg over each side pointed to the water, under two terrific vertical pinnacles between two and three hundred feet in elevation. These actually vibrated with the force of the wind, and appeared altogether so shattered and unstable, that it was astonishing how they remained erect. I was far from being at ease in such a threatening situation, and therefore made a hasty retreat, by sliding down the side opposite to that by which I had ascended, a good deal rejoiced to find that this being less steep and not so dangerously interrupted by precipices, afforded a much safer descent than the other. I then skirted the base of the cliff to the northward with some difficulty, until I reached a strip of ice firmly frozen to the ground and partly under water. On this I was enabled to travel to an extensive plain near Cape Mewburn. Here I observed renewed traces of inhabitants. The ground-plots of two summer huts were clearly laid out; and an external fire-place, with ashes and portions of charred-wood, yet remained. Numbers of pieces of manufactured bones were also picked up."

It is with reluctance we pass over Captain Scoresby's description of a very remarkable escape from impending destruction, on the 11th August 1822, which affords a lively picture of the extreme dangers to which navigators are exposed in traversing the northern seas. The same navigator's observations on the tides in Davy's sound, seem peculiarly worthy of attention. "The fierce tides," says he, "in the opening of Davy's sound, when there is much ice about, render the approach to the land, especially on the southern side of the sound, not a little dangerous; for when any of the heavy floes take the ground, or come in contact with grounded bergs or other ice, so as to be brought up, the neighbouring floes are swept against them by the strong influx of water with great rapidity and with astonishing force. Besides, the set of the tide is so various in different positions, (determined probably by the nature of the adjoining coasts or inlets, and possibly influenced by the position of the ice,) that the effect can seldom be fully estimated. On passing the point of the floe which we experienced so much difficulty in doubling, there was a rippling on the surface of the water like a race, arising apparently from a change in the set of the tide; and, on crossing it, the ship refused the helm, though her headway was rapid and the gale strong, so as to spring up against the helm nearly head to wind. When we first moored to the ice abreast of Cape Moorsom, we observed very little stream, though the tide was so fierce a few miles to the northward. Hence it is likely that the tide may divide in this position, being nearly in the middle between Mountnorris inlet and Davy's sound, and a separate branch run up each inlet."

During the remainder of the time that Captain Scoresby was engaged in surveying the Greenland coast, he experienced little interruption except from occasional foggy days, on one of which he was happily occupied in making observations on the atmospheric phenomena of coronae and anthelia. Observing many intimations of approaching winter, he determined to return home; and the Baffin having finally quitted the Greenland seas about the end of August, reached Liverpool, the port from which she sailed, in less than a month after. On her return home she had to encounter a dreadful storm, in which one of the harpooners was washed overboard. It must be admitted that this navigator's hydrographic survey of the Greenland sea is not a little creditable to his zeal and ability as a scientific observer; while to the general reader it possesses no small interest, from the perspicuous and unaffected manner in which it is drawn up.

It now remains for us to notice the recent expedition of Captain Parry by sea, and that of Captain Franklin overland, for the purpose of ascertaining the reality of a north-west passage from Baffin's bay to the Pacific.

The company belonging to the latter of these expeditions at first consisted of Lieutenant (now Captain) Franklin, of the royal navy, the commander, Dr Richardson, a navy surgeon, Mr Buck and Mr Hood, admiralty midshipmen, and an English sailor of the name of Hepburn. On the 23d of May 1819 this party embarked at Gravesend, and on the 30th of August following arrived at York factory, one of the chief settlements of Hudson's bay Company, situate in North Lat. 57°, and West Long. 92° 26′.—They took a westerly direction from this point to Cumberland-house, which they reached in December, after a journey of about 690 miles. Leaving Dr Richardson and Mr Hood to spend the Winter at Cumberland-house, and afterwards to join them at Fort-Chipewyan, partly by another route, Captain Franklin with, Mr Buck and Hepburn the sailor, set out from that place on the 19th of January 1820, and arrived at Fort-Chipewyan, on the Athabascan lake, about the close of the month of March, where, on the 13th July following, they were joined by Dr Richardson and Mr Hood. Shortly after, the whole party proceeded northward, and arrived, by the close of July, at Fort-Providence, on the Great Slave lake. At this place their number had increased to 28 persons, including about 20 Canadian voyagers; and they moreover formed a connection with a tribe of Copper Indians. The Canadian voyagers were, with difficulty, hired by Captain Franklin to assist in proceeding with the expedition, and it was hoped that the Copper Indians might be of service in obtaining information and supplies. Though the commander had now many hardships to encounter, from the difficulty of navigating the rivers, and from the store of provisions beginning to fall short, he determined not to relinquish the undertaking in which he had embarked. After proceeding on a visit of observation to the nearest point of the Copper-mine river, the circumstance of the cold setting rapidly in obliged him, on the 13th September, to return to a spot to which they not unaptly gave the appellation of Fort-Enterprize, and where they fixed their winter quarters. About the middle of June in the following year, they renewed their journey towards the Arctic ocean. From York Factory, they had now travelled a distance of about 22,000 miles, including their short excursion to the upper part of Copper-mine river. Throughout this fatiguing journey, they took a course consisting of one great chain of rivers and lakes; and the laborious conveyance of their baggage across the portages which frequently came in their way, being occasioned either by rapids or by the absence of a navigable stream, proved extremely disheartening. The Winnipeg, the Athabasca, and the Slave lakes, were the chief lakes touched upon or traversed by the party. Various tribes of Indians, the chief of which are the Cree, the Stone, the Chipewyan, and the Copper Indians, are thinly scattered over the vast central district of North America that lies to the east of the Rocky mountains. These tribes are distinguished by varieties of aspect and manners; and they derive a precarious subsistence from hunting, besides which they have scarcely any other occupation. The Cree Indians inhabit the country adjacent to Cumberland-house. They are an indolent and improvident race, remarkable chiefly for a propensity to boasting, which is the most offensive part of their character; yet they regard the rights of property, and are hospitable and pacific in their disposition. Every individual of this tribe dreads the conjuring powers of his neighbour, while, of his own attainments, he affects to entertain a lofty opinion. The expression *I am godlike*, is common amongst them; and by various tricks, such as eating live coals, they prove their divinityship. Of a Cree's equipment, one indispensable part is a medicine bag, which is commonly furnished with a little bit of indigo, blue vitriol, vermilion, or some other shewy substance; and is, when in the hands of a noted conjuror, an object of unspeakable terror. The scantiness of the population of this tribe may be estimated from the following circumstance, that a district comprehending, on a rough calculation, no less than 20,000 square miles, is at present frequented by only about 120 hunters, with their families. The Stone Indians are so regardless of the rights of property, that they take every opportunity of committing theft, and do not hesitate to murder before they rob, when they expect resistance. Yet though treacherous and cruel in their disposition, their countenances are affable and pleasing. They are of a light copper colour—have large and expressive eyes,—and are tall and slender, but well proportioned. When equipped for warfare, the individuals of this race assume an air of perfect independence. The Chipewyan Indians, who are said to be less hospitable than the Crees, and less warlike than the Stone Indians, seem to constitute a distinct tribe, remarkable for a reserved manner, and for extreme selfishness. The Copper Indians border on the Esquimaux, who inhabit still more northerly districts, and of whom several traces were found on the coast of the Polar sea.

The following extract from Dr Richardson's account of the Cree Indians, exhibits a trace of mingled fortitude and feeling which, in a savage, is not a little admirable:—" One evening early in the month of January, a poor Indian entered the North-west Company's house, carrying his only child in his arms, and followed by his starving wife. They had been hunting apart from the other bands, had been unsuccessful, and whilst in want were seized by the epidemical disease. An Indian is accustomed to starve, and it is not easy to elicit from him an account of his sufferings. This poor man's story was

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very brief—as soon as the fever abated, he set out with his wife for Cumberland-house, having been previously reduced to feed on the bits of skin and offal which remained about their encampment. Even this miserable fare was exhausted, and they walked several days without eating, yet exerting themselves far beyond their strength that they might save the life of the infant. It died almost within sight of the house. Mr Conolly, who was then in charge of the post, received them with the utmost humanity, and instantly placed food before them; but no language can describe the manner in which the miserable father dashed the morsel from his lips, and deplored the loss of his child."

Captain Franklin and his party sustained great hardships even at lat. 53°. Their arrival at Fort-Providence, which is situate at the northern part of the Great Slave lake, was expected by Mr Wentzel, agent of the North-west Company, to whose care were intrusted the management of the Indians, the superintendance of the Canadian voyagers, and the collection and distribution of stores and provisions, and who appeared ready to afford the travellers every information and facility for the prosecution of their arduous journey.

In their progress from Fort-Enterprize to the mouth of the Copper-mine river, a distance of about 334 miles, our travellers had to endure great difficulties and hardships; and for 117 miles of the distance between these two points they had to drag their canoes and baggage over snow and ice. Indeed their sufferings daily increased, till the party at length presented a picture of misery which it is painful to contemplate. The hunters were now only five in number, and the killing of a single deer became a matter of no small importance. They, however, shot some musk oxen, which animals frequent these high latitudes in the summer season, and feed on the same substances with the rein-deer. On the 14th of July they obtained the first view of the sea, which appeared covered with ice, and on the day following they arrived at a spot strewn with human skulls, which appeared to be the place called Bloody Fall, where the Chipewyans, who accompanied Hearne, perpetrated their horrid massacre on the Esquimaux. On the 18th of the same month, and after a journey from Fort-Enterprise of about thirty days, they reached the sea, which is distant only nine miles from the spot just mentioned, and embarked in two small canoes, without any certainty whither their course might lead them. Their situation was now hazardous in the extreme, for while they had to dread the attacks of want and famine on the one hand, they were in imminent peril from the shock of storms or floating ice on the other, as appears from the following account of their doubling Cape Barrow: "At noon the wind coming from a favourable quarter, tempted us to proceed, although the fog was unabated. We kept as close as we could to the main shore, but having to cross some bays, it became a matter of doubt whether we had not left the main, and were running along an island. Just as we were endeavouring to double a bold cape, the fog partially cleared away, and allowed us an imperfect view of a chain of islands on the outside, and of much heavy ice which was pressing down upon us. The shore near us was so steep and rugged that no landing of the canoes could be effected; and we were preserved only by some men jumping on the rocks, and thrusting the ice off with poles. There was no alternative but to continue along this dreary shore, seeking a channel between the different masses of ice which had accumulated at the various points. In this operation both the canoes were in imminent danger of being crushed by the ice, which was now tossed about by the waves that the gale had excited." They shortly after penetrated into a gulf indented by numerous inlets, and abounding with islands, descended to the bottom of it, and coasted along its eastern boundary, till they reached a point of land to which they gave the name of Point-turn-again, from the circumstance of their being absolutely unable to proceed farther eastward. As their store of provisions was now very limited, and they had little prospect of increasing it to any adequate supply, they determined to return across the country to Fort-Enterprise, and accordingly embarked inland at the mouth of a river which empties itself into Arctic sound, and which they denominated Hood's river. While the party coasted from the mouth of the Copper-mine river to Point-Turn-again, they saw no human being, though they noticed some traces of the Esquimaux.

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Captain Franklin having, in the month of August 1821, planted the English flag on a lofty sand hill near the mouth of Hood's river, and left on the same spot a tin box containing a letter for Captain Parry in case he should touch at these points, directed his course up the river, with the view of proceeding as far as it might prove navigable, and then constructing small canoes out of the materials of the large ones, which might be carried on men's shoulders in crossing the barren grounds of Fort-Enterprise. Their sufferings during their return were incomparably great; and a more affecting tale of physical distress than that we have now to narrate, was perhaps never recorded. Such was the severity of the climate, that even at this early season snow was upon the ground, the pools were frozen, and few animals were to be seen. We have already adverted to the scantiness of their provisions; these were diminishing rapidly, and their ammunition also, upon which they chiefly depended for their support. Having proceeded little way up the river, our travellers arrived at a dreadful chasm with perpendicular walls, about 200 feet in height, where its waters are precipitated over a rock, forming two great waterfalls, to which they gave the name of Wilberforce-falls, as a tribute of respect for that distinguished Christian and philanthropist. From the 3d of September, when they quitted the river to proceed across the country to Point Lake, to the 7th of November, when they were relieved by the arrival of a few Indians at Fort-Enterprise, the narrative of their miseries is such as to excite feelings of the most painful interest. They had to travel through the snow, which was a foot deep, and to pass over frozen swamps, where, from the insufficient strength of the ice, they often plunged in water; and they were under the necessity of sleeping in their socks and shoes, drenched as they were with water, in order to prevent them from

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freezing. They were, moreover, reduced to the last extremity for want of provisions, having scarcely any other means of subsistence besides a species of lichen called *tripe de roche*, while the ordinary pains of hunger were increased by that keenness of appetite which cold and exercise are calculated to engender. Whole days were passed by them without receiving any support, and they were at length reduced to subsist on pieces of skin and bones of deer that had been devoured by wolves. Their fishing-nets and floats had been destroyed, and their only remaining canoe was entirely broken before they reached the banks of Copper-mine river, where they had no opportunity of constructing a new one, having neither materials nor convenience for that purpose. In this desperate exigency every attempt was made to cross the river during eight days from their arrival on the 26th of September. For the purpose of constructing a raft, they commenced binding willows in faggots, but after having finished it with all possible dispatch, they were mortified to find that from the greenness of the willows, it was not sufficiently buoyant. Yet, though it could only support one man at a time, they, notwithstanding, indulged the hope that the whole party might be transported by hauling it from one side to the other, provided a line could be carried to the other bank. Several attempts were made by Belanger and Benoit, the strongest men of the party, to convey the raft across the stream, but they failed for want of oars. A pole, constructed by tying the tent poles together, was too short to reach the bottom at a short distance from the shore; and a paddle which had been carried from the sea coast by Dr Richardson, did not possess sufficient power to move the raft in opposition to a strong breeze which blew from the opposite shore. All the men suffered extremely from the coldness of the water, in which they were necessarily immersed up to the waist in their endeavours to aid Belanger and Benoit; and having witnessed repeated failures, they began to consider the scheme as hopeless. At this time, Dr Richardson, prompted by a desire of relieving his suffering companions, proposed to swim across the stream with a line, and to haul the raft over. He launched into the stream with a line round his middle, but when he had got a short distance from the bank, his arms became benumbed with cold, and he lost the power of moving them; still he persevered, and turning on his back, had nearly gained the opposite bank, when his legs also became powerless, and to their infinite alarm we beheld him sink. They instantly hauled upon the line, and he came again on the surface, and was gradually drawn on shore in an almost lifeless state. Being rolled up in blankets, he was placed before a good fire of willows, and fortunately was just able to speak sufficiently to give some slight directions respecting the manner of treating him. He recovered strength gradually, and was enabled, in the course of a few hours, to converse a little, and by the evening was sufficiently recovered to remove into the tent. It was then ascertained that the skin of his whole left side was deprived of feeling, in consequence of exposure to too great heat. He did not perfectly recover the sensation of that side until the following summer. It was distressing to behold the skeleton which Dr Richardson's debilitated frame exhibited.

By means of a wretched canoe, or rather basket, the party at length succeeded, one by one, in reaching the opposite shore; but it was greatly injured by their frequent traverses, and, towards the last, filled each time with water before reaching the shore. None of the party had as yet perished, but, from the united severities of cold, hunger, fatigue, and despondency, a few of the Canadians became exhausted, and unable to proceed with their companions in distress. Mr Buck, with three of the Canadians, was now sent in search of relief from the Copper Indians, while the rest of the party moved on in the best manner they could; but while Captain Franklin bent his course with much difficulty towards Fort-Enterprize, Mr Hood was in such a state of exhaustion that he was unavoidably left behind with Dr Richardson and Hepburn. Captain Franklin's party was in a short time reduced to five or six persons, including himself, the rest having sunk under privation and fatigue.

Our travellers' spirits were buoyed up with the prospect of obtaining relief on their arriving at Fort-Enterprise, as Mr Wentzel had promised to lay up a store of provisions for them there, in case they should return that way. From want of means, or of proper diligence, however, that individual had failed to perform his promise; and, on reaching the fort, they had the mortification to find it destitute of supplies. This neglect of Mr Wentzel was the occasion of much of their subsequent calamities. Belanger arrived shortly after with a note from Mr Buck, signifying that he had not been able to discover any trace of the Indians. The temperature was now 15° and 20° below zero. From the 12th of October to the 7th of November, they remained at the fort in a state of the greatest destitution; and, indeed, a very few days more must have sealed the destruction of the whole party, had not some Indians, whom Mr Buck had at length met with, and informed of their condition, providentially arrived for their relief. It may here be observed, that only five or six of the eighteen Canadians, who had accompanied the expedition, survived their dreadful sufferings. The Canadians became spiritless in the midst of difficulties and dangers, and some of them fell behind from time to time; but the English were borne up by a firmer tone of animal spirits, increased in no small degree by the influence of religious feelings and considerations. Dr Richardson and Hepburn, the only poor remains of the party who had been left in the rear, joined Captain Franklin on the evening of the 29th of October. Their emaciated countenances strongly evidenced their debilitated state, for they appeared little more than skin and bone. From the account of the meeting we take the following extract: "The Doctor particularly remarked the sepulchral tone of our voices, which he requested us to make more cheerful if possible, unconscious that his own partook of the same key. Hepburn having shot a partridge, which was brought to the house, the Doctor tore out the feathers, and having held it to the fire a few minutes, divided it into seven portions. Each piece was ravenously devoured by my companions, as it was the first morsel of flesh any of us had tasted for thirty-one days, unless indeed the small gristly particles which we found occasionally adhering to the pounded bones may be termed flesh. Our spirits were revived by this small supply, and the Doctor endeavoured to raise them still higher by the prospect of Hepburn's being able to kill a deer next day, as they had seen and even fired at several near the house. He endeavoured, too, to rouse us to some attention to the comfort of our apartment, and particularly to roll up in the day our blankets, which (expressly for the convenience of Adam and Samandrè) we had been in the habit of leaving by the fire where we lay on them. The Doctor having brought his prayer-book and testament, some prayers and psalms, and portions of scripture appropriate to our situation, were read, and we retired to bed."

The Indians behaved towards the party in the most obliging manner, and afforded no small relief. On the 10th of November Captain Franklin and his followers left Fort-Enterprise, and proceeded to Fort-Providence, which they reached on the 11th of December, where they felt inexpressible sensations of pleasure on being once more in a comfortable dwelling. They remained here about five months, during which interval they were nearly restored to their accustomed health and vigour. They embarked for Fort-Chipewyan about the latter end of May, and afterwards directed their course to York-Factory, which they reached on the 14th of May 1822, after an absence of nearly three years; in which space of time they had journeyed by land and water 5550 miles.

Captain Franklin favours the opinion, that a north-west passage may be practicable; and by the discoveries of Captain Parry's first voyage, combined with those of our present travellers, it seems to have been almost ascertained that there is a vast ocean to the north of Copper-mine river studded with islands of very various extent. The practicability of navigating this ocean, however, is a point which has been rendered more and more doubtful by the result of the late expedition to Repulse bay. It must at same time be admitted, that as the distance between the head of Chesterfield inlet and the most easterly point of Captain Franklin's journey appears comparatively speaking so short, the discovery of the whole line of coast which forms the northern boundary of the American continent may yet be hoped for.

It now remains to give some account of Captain Parry's second expedition to the polar regions, which, as before, consisted of the Fury and the Hecla. These vessels being equipped in the most judicious manner, and provisioned for three years, sailed from the Nore in May 1821. The Nautilus, a store ship, accompanied them till the whole reached Resolution island, at the mouth of Hudson's straits, where the Nautilus, having unloaded her cargo into the Fury and Hecla, left them on the 1st of July. Captain Parry now calculated on devoting three summers to his daring enterprise, and only wished that, if not heard of in the beginning of 1824, a vessel with provisions might be sent into Behring's strait in the autumn of that year. This voyage, performed in the years 1821, 1822, and 1823, was designed, as we have already hinted, to receive in its main object the co-operation of Captain Franklin's party. The navigators, while passing up Hudson's straits, were visited by a tribe of Esquimaux belonging to the Savage islands in these straits. We learn, from Captain Parry's Journal, that these people were not unacquainted with Europeans, and that they possessed in an eminent degree the disposition to steal all they could lay their hands on, which has almost universally been imputed to every tribe of Esquimaux hitherto visited by Europeans. "They tried more than once the art of picking our pockets, and were as bold and unembarassed as ever immediately after detection. It is impossible to describe the horrible disgusting manner in which they sat down, as soon as they felt hungry, to eat their raw blubber, and to suck the oil remaining on the skins we had just emptied, the very smell of which, as well as the appearance, was to us almost unsufferable. The disgust which our seamen could not help expressing at this sight, seemed to create in the Esquimaux the most malicious amusement; and, when our people turned away literally unable to bear the sight without being sick, they would, as a good joke among themselves, run after them, holding a piece of blubber or raw seal's flesh dripping with oil and filth, as if inviting them to partake of it. A worse trait even than all these was displayed by two women along side the Hecla, who, in a manner too unequivocal to be misunderstood, offered to barter their children for some articles of trifling value, beginning very deliberately to strip them of their clothes, which they did not choose to consider as included in the intended bargain. Upon the whole, it was impossible for us not to receive a very unfavourable impression of the general behaviour and moral character of the natives of this part of Hudson's straits, who seem to have acquired, by an annual intercourse with our ships for nearly a hundred years, many of the vices which, unhappily, attend a first intercourse with the civilized world, without having imbibed any of the virtues or refinements which adorn and render it happy."

The expedition attained 86° of west longitude, and 69° 48′ of north latitude. During the summer Captain Parry was chiefly employed in exploring Repulse bay, and some inlets to the eastward of it, in hopes of finding a passage to the polar sea. In the beginning of October, the frost set in so fast that the ships were scarcely manageable, or the sea navigable. It was then deemed prudent to look out for a place to winter in, and a small shallow bay was accordingly found, which promised a shelter from the northerly winds and drift ice. A canal was cut in the new formed ice, and the ships properly placed by the 18th of the same month about a quarter of a mile from the shore. The vessels were shortly afterwards frozen up, and snugly housed over, and otherwise prepared for the winter, which now set in very fast; the land was covered with snow, and deserted by al-

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most every animal, with the exception of foxes and bears. The expedition was detained at Winter island, from the date just mentioned to the 2d of July 1822; and the loss of the season among a few bays and creeks of no importance, led to the conviction that a passage through Repulse bay was not attainable. Our navigator remarks, that in reviewing the events of this first season of navigation, and considering what progress had been made towards the attainment of the main object in view, it was impossible, however trifling that progress might appear upon the chart, not to experience considerable satisfaction. "Small," says he, "as our actual advance had been towards Bhering's straits, the extent of coast newly discovered and minutely explored in pursuit of our object in the course of the last eight weeks, amounted to more than 200 leagues, nearly half of which belonged to the continent of North America. This service, notwithstanding our close exposure to the risks which intricate shoals and unknown channels, a sea loaded with ice and a rapid tide, concurred in presenting, had providentially been effected without injury to the ships or suffering to the officers and men, and we had now once more met with tolerable security for the ensuing winter, when obliged to relinquish farther operations for the season. Above all, however, I derived the most sincere satisfaction from a conviction of having left no part of the coast from Repulse bay eastward in a state of doubt as to its connection with the continent. And as the mainland now in sight from the hills extended no farther to the eastward than about a north north-east bearing, we ventured to indulge a sanguine hope of our being very near the north-eastern boundary of America, and that the early part of the next season would find us employing our best efforts in pushing along its northern shores."

The apparatus for heating between decks was now found in both ships to be productive of much comfort to the men. During the winter, the recreations and amusements of the officers became so regular, that the history of a single day may suffice for the whole season. At seven o'clock in the morning they got up, at eight breakfasted, at nine they mustered on deck. At one P. M. they dined; the afternoon was spent by some in sleep, others reading, or playing chess, backgammon, or cards, till five o'clock, when tea was introduced; at six they attended muster, and at eight they supped, after which they usually read or conversed until bed-time. Besides amusing themselves with walking over the snow and killing foxes, for which purpose every officer contrived to have a fox-trap, they enjoyed dramatic representations, and had occasional concerts. In both ships a regular school was established, and divine service was regularly observed.

In the beginning of February 1822, when the time began to hang rather heavy on their hands, a seasonable relief appeared in a tribe of about 50 Esquimaux who were observed erecting their snow huts and taking up their residence at a short distance from the vessels. This sight was very unexpected, as our navigators, after leaving Hudson's straits, had seen only one family of the Esquimaux, although in every place they landed they met with remains of their huts. These people roam along the shore in search of food, and are supposed never to make their habitations many miles from the water's edge, as they depend for their sustenance chiefly upon the produce of the sea. They came toward the ships without hesitation, entirely unarmed; and, on coming on board, they looked round either with the most stupid indifference or were struck dumb with astonishment, as they had never seen a ship before, nor indeed a man besides their own race. From the peculiarity of the manners of their new and singular neighbours, the voyagers enjoyed very much the intercourse with them during the remainder of the winter. Captain Parry gives the following description of a party of these seal hunters: "They were seated on a high hummock of ice, with their spears in their hands, looking out for seals. After we had talked to them for a few minutes, Okotook suddenly started up, and set off along the edge of the ice without giving us or the rest of his companions the least warning. The latter seemed so much accustomed to this, that they took no farther notice than by immediately following him, and we did the same; the whole party walking at a very quick rate, and the natives keeping their heads constantly turned twards the sea to look out for seals. After being thus engaged for an hour and a-half, we judged, from the motions of a party at some distance beyond us, that they had game in view. As we approached them, Okotook evidently began to be apprehensive that we, who did not understand the matter, would spoil their sport. To prevent this, he did the most civil thing that could well have been devised, which was to send his companions one by one to the spot, and to remain with us himself, keeping us at such a distance as to allow us to see their proceedings without alarming the animal they were in pursuit of. The other seven Esquimaux now forming one party, disposed themselves into a single line, so as to make as small an appearance as possible in the direction in which they were going, and in this manner kept very cautiously towards the margin of the floe. On a sudden they all stooped down quite low to hide themselves, and continued thus a quarter of an hour, during which time they prepared their lines and spears; and then when the animal appeared to be intercepted from their view, again took the opportunity of gaining a few paces upon him in the same cautious manner as before. When they had been thus occupied for a full hour, alternately creeping and stooping down, the seal, which had been lying on the ice, took the water, and then they gave up their chase. During this time, Okotook could scarcely restrain his impatience to be nearer the scene of action; and when we produced a spy-glass, which appeared to bring his companions close to us, he had not words to express his surprise and satisfaction. In a short time he held it as steadily as we did, and explained by signs every motion he observed.

"As soon as they had given up the seal they had been watching, the whole party seemed, with one accord, to turn their steps homeward, in which direction, being that of the ships also, we were by this time not sorry to accompany them. We were now between three and four miles north-east of the ships, and full a mile and a half from any part of the shore. In the open water, beyond the floe, the tide was running two notes to the northward, and as the ice on which we stood had been formed only within the last fortnight, and a sheet as substantial as this had before been carried away by the stream, it was impossible not to feel some apprehension lest we might thus be detached from the shore, an accident that has been known to happen to Esquimaux ere now, and has probably more frequently befallen them when none has survived to tell the tale. As we returned towards the land, we came to a small rising on the level surface of the floe, not larger than a common mole hill, and of much the same shape, at which one of the Esquimaux immediately stopped. His companions still walking on, called us away, explaining that what we saw was the work of a seal, and that it was probable the animal was about to complete his hole, and to come up on the ice, in which case the man would endeavour to kill him. We watched the man at the hole, however, with a glass, for more than half an hour, observing him constantly putting his head down towards the ice, as if in the act of listening for the seal, but without otherwise changing his position; after which he followed us on board without success. If, however, a man has any reason to suppose that a seal is at work beneath, he immediately attaches himself to the place, and seldom leaves it till he has succeeded in killing the animal. For this purpose he first builds a snow wall, about four feet in height, to shelter him from the wind, and seating himself under the lee of it, deposits his spear, lines, and other implements, upon several little forked sticks inserted into the snow, in order to prevent the smallest noise being made in moving them when wanted. But the most curious precaution, to the same effect, consists in tying his own knees together with a thong, so securely as to prevent any rustling of his clothes, which might otherwise alarm the animal. In this situation a man will sit quietly sometimes for hours together, attentively listening to any noise made by the seal, and sometimes using the keip-kuttuk, an instrument to ascertain whether the animal is still at work below. When he supposes the hole to be nearly completed, he cautiously lifts his spear to which the line has been previously attached, and as soon as the blowing of the seal is distinctly heard, and the ice consequently very thin, he drives it into him with the force of both arms, and then cuts away with his pannon the remaining crust of ice, to enable him to repeat the wounds and get him out. The neitiek, (*phoca hispida,*) is the only seal killed in this manner, and being the smallest, is held while struggling, either simply by the hand, or by putting the line round a spear, with the point stuck into the ice. For the oguke, (*phoca barbata,*) the line is passed round the man's leg or arm; and for a walrus, round his body, his feet being at the same time firmly set against a hummock of ice, in which position those people can, from habit, hold against a very heavy strain. Boys of fourteen or fifteen years of age consider themselves equal to the killing of a neitiek, but it requires a full grown person to master either of the large animals.'

Instances are not wanting of remarkable intelligence in the Esquimaux. Captain Parry, in giving an account of a female called Iligliuk, who was extremely serviceable as an interpreter, observes, "I am, however, compelled to acknowledge, that in proportion as the superior understanding of this extraordinary woman became more and more developed, her head (for what female head is indifferent to praise!) began to be turned with the general attention and numberless presents she received. The superior decency, and even modesty of her behaviour, had combined with her intellectual qualities to raise her in our estimation far above her companions; and I often heard others express what I could not but agree in, that for Iligliuk alone, of all the Esquimaux women, that kind of respect could be entertained which modesty in a female never fails to command in our sex. Thus regarded, she had always been freely admitted into the ships, the quarter-masters at the gangway never thinking of refusing entrance to the 'wise woman,' as they called her. Whenever any explanation was necessary between the Esquimaux and us, Iligliuk was sent for quite as an interpreter; information was chiefly obtained through her, and she thus found herself rising into a degree of consequence to which, but for us, she could never have attained. Notwithstanding a more than ordinary share of good sense on her part, it will not therefore be wondered at if she became giddy with her exaltation, assuming certain airs which, though infinitely diversified in their operation, according to circumstances, perhaps universally attends a too sudden accession of good fortune in every child of Adam from the equator to the poles. The consequence was, that Iligliuk was soon spoiled,—considered her admission into the ships and most of the cabins no longer as an indulgence but a right,—ceased to return the slightest acknowledgment for any kindness or presents,—became listless and inattentive in unravelling the meaning of our questions, and careless whether her answers conveyed the meaning we desired. In short, Iligliuk in February, and Iligliuk in April, were confessedly very different persons; and it was at last amusing to recollect, though not very easy to persuade one's self, that the woman who now sat demurely in a chair, so confidently expecting the notice of those around her, and she who had at first, with eager and wild delight, assisted in cutting snow for the building of a hut, and with the hope of obtaining a single needle, were actually one and the same individual."

Throughout the winter months the voyagers lived in the greatest friendship with the Esquimaux, occasionally supplying them with a mess of bread-dust and oil, in return for which they were favoured with their sledges to ride on. In the summer of 1822, the vessels having steered along the coast to the north, penetrated to the long. of 82° 50′, and lat. 69° 40′, and they were at length moored for the winter in west long. 81° 44′, and north latitude 69° 21′, where, close to a small island, they remained from the 24th of September 1822 to the 8th of August 1823. Our navigators having sailed about 15 leagues within the entrance of a strait, which, from what they could learn from the Esquimaux and their own observations, they were led to suppose separated all the land to the northward from the continent of America, they were stopped by the ice. Persuaded, however, that they were in the proper channel for getting to the westward, they remained there until the 19th of September, in hopes that the ice would break up; but the ice then setting in, very nearly froze the ships up, and it was with some difficulty that they got out of the strait. They now resolved to return to the island in the bay inhabited by natives, and by them called Ilgoolik, where they arrived at the end of the month, and laid the ships up in winter quarters.

During the second winter a considerable number of Esquimaux, including the visitors of the preceding year, having among them an angekok, or conjuror, who exercised a certain degree of influence and authority, settled within a short distance of the ships. As their manners and customs are somewhat interesting, we shall here gratify the reader with a brief account of them. The Esquimaux were at first rather reserved and incommunicative, but as this reserve wore off, they divulged a number of curious particulars. They had no hesitation in bartering their wives and children for so insignificant a bribe as a nail, or two or three beads, or for a paltry knife. They are of a dirty-looking yellowish-white colour; their proportions are by no means robust; and in stature none of them was found to exceed five feet ten inches. They are generally peaceable and good natured, and many of them were observed to be above sixty years of age. It is not uncommon for a native to have two wives, one of which is almost always somewhat younger than the other, and the children in a family seldom exceed three or four. The features of the females are disagreeable, and they have long and harsh, but extremely black hair. The great-grandmother of a child of about seven years of age was met with, who was a healthy old woman, at the head of four generations. The huts of the Esquimaux are constructed entirely of snow, arched over like a baker's oven, but high enough to stand upright in; on each side is a bench of snow, covered with skins, which serve as the seat and bed of the family. Each hut is about 12 feet in diameter; the door is usually about 18 inches in height, and three or four of the huts communicate with a covered passage, having one common door. A piece of flat transparent ice serves for a window. In their oil lamps, they use for wicks pieces of dry moss, and the huts are without any artificial warmth except what proceeds from the lamps. Native houses, constructed of bone, were also observed in the winter of 1822-3. Flesh, in a raw state, is often eaten by the Esquimaux,—but the women commonly submit their food to a process of cooking, the utensils for which purpose consist of two stones, usually the pot-stone, or lapis-ollaris. The lower vessel is not unlike an English kitchen ash-shovel, while the upper one in which the meat is stewed, is a trough of the form of a coffin. The former is filled with oil; and a number of moss wicks which float in it, are lighted to serve for fuel. Being remarkably foul feeders, the Esquimaux actually make use of any thing for food, from the blubber of a whale to the flesh of a wolf; and, indeed, their food chiefly consists of seal and wolve's flesh, with which they appear to be perfectly contented. When the lapis-ollaris cannot be found for making cooking utensils, a cement, composed of dog's hair, seal's blood, and a certain kind of clay, which has the virtue of becoming as hard as stone in a short time, and bearing the effects both of oil and fire below, and moisture and stewing above, is substituted in its place. The Esquimaux clothe themselves in the skins of deer and other animals. Each family is in possession of a sledge and several dogs for travelling and hunting. Among them, there appear to be no signs of the worship of a Supreme Being, nor are there any religious ceremonies at marriages or burials. A native bespeaks his wife while she is in infancy, and when she becomes of age she is brought to him, on which occasion there is a feast. Their mode of interring the dead is very simple. In winter the custom is merely to cover the corpse over with snow, and in summer to deposit it in a shallow trench, dug for the purpose. No stones or earthy matter are placed on the corpse, from a superstitious notion that the body, even after death, might be sensible to the oppression. Of a future state they do not seem to have any consistent ideas; but they entertain some vague notions of spirits or superior beings, whom they invoke on extraordinary occasions. They maintain that their race sprung originally from a beneficient female spirit, and that from another female spirit are descended the Itkali, or Indians, the Cablunae, or Europeans, and also the dogs which they drive. Of the Itkali they have the worst opinion possible, and of the Europeans they do not seem to have any flattering opinion, though they had never seen one before they encountered those in the Fury and Hecla. The name Esquimaux is by no means familiar to them, and is understood as a term of reproach, signifying eaters of raw flesh; but they denominate themselves *Enuee*. On leaving the Esquimaux, some muskets of small value were given to them; and one native and his wife were willing to come to England, but the trouble and the uncertainty of returning them to their own country prevented their voyage. Our people were enabled to acquire a copious vocabulary of their language, and above five hundred words are contained in some of the journals. Of figures the Esquimaux have a very limited conception, five and ten being their most obvious enumerations. The former they express by one hand, and the latter by holding up both; and to express a greater number, the assistance of another person is required, who holds up one or two hands according to the sum. They are well known to be remarkably expert in the management of their canoes, which are astonishingly light, and formed of skin over whale-bone. They are also very active in the use of the spear, and the bow and arrow. The spear is double-pointed with bone, about six inches long, and barbed. Its shaft is of very light wood, about five feet in length, and having, below the handle, three other barbed bones projecting a few inches from the wood, which are calculated to strike the prey, should the biforked point miss. With this instrument they can kill at the distance of twenty yards. Their arrows are pointed with stone, smoothed into a lance-head shape by rubbing against other stones. The knives used by the women for skinning animals and carving victuals, are in form not unlike a small cheese or a saddler's knife; they are three or four inches long, with an edge three or four inches broad.

In their behaviour to old people, where age or infirmities render them useless or burthensome to the community, the Esquimaux betray a degree of insensibility bordering on inhumanity. A striking instance of cruelty to the widow of an Esquimaux was witnessed by Captain Parry. This poor destitute woman was disgracefully treated by her tribe, and even kinsmen, and was discovered in a dying condition, owing apparently to desertion, robbery, and want. Our voyagers, however, considered the character of the natives as much superior to that of persons in general in savage life. Devoid of religion, and particularly of the principles of Christianity, which are calculated to elevate and inform the mind, they were under the influence only of sensual and selfish principles; consequently, it is not surprising that they were not better. They evinced considerable ingenuity in the manufacture of articles of clothing; and some of them readily comprehended the nature of charts, and even drew plans on paper of the contiguous coasts with tolerable accuracy.

In performing journies over land, the Esquimaux dog is of infinite value. These animals, which, from their fierceness, are more like wolves than dogs, draw the country sledges at the rate of five miles an hour, and eight of them in harness will draw three or four persons with ease and speed. In the chase, also, they are bold and vigorous,—seizing the polar bear, and detaining him till their masters arrive to end the conflict by means of their spears. They are of various colours, tan, grey, but generally black, with white spots over the eyes, and on the feet and tip of the tail. They snarl, growl, and howl in a savage manner, but do not bark. These hardy animals are often destroyed by the wolves, which hunt in packs, and drag their prey from the huts to devour them. At one time, a dog was borne away from the Fury by the wolves, notwithstanding the pursuit of the men. The latter, attracted by the scent, were always prowling about the vessels; and, thirteen of them were observed in a pack one day, all of which were trapped and slain, and given to the hungry Esquimaux, who feasted upon them.

The information conveyed by Captain Parry's Journal is doubtless very interesting; yet it cannot be denied, that the expedition has failed in its leading objects in spite of the perseverance of our navigators. Perhaps little, if any new light, can be thrown by it upon the great questions of science which the former voyages suggested. The magnetic pole was not crossed; and it is curious to state, that to the south were observed all the electrical appearances, lights, halos, and meteors. The course taken upon the present occasion does not seem to have answered the expectations formed, or to promise any advantageous results for the attempts of future navigators. Indeed, so unproductive does the last year of the expedition seem to have been, that the ships might as well have returned home in the autumn of 1822. The inlet, where the second winter was spent, presented a solid mass of ice. Its breadth is said to be about ten miles; but its length is not known. The ebb tide is from the south-west, and the flood from south-east; and small channels run through it, which are not of sufficient width to work a ship. The vessels do not seem to have encountered much danger from the ice while they lay at this inlet. The absence of the sun was experienced for about a month.

The ships touched at Winter island on their voyage home, where our people were gratified to find their garden vegetables in a thriving condition. They arrived at Lerwick in Shetland on the 10th of October 1823, made the northern coast of England on the 16th, anchored in the Galleons, about three miles below Woolwich, on Tuesday the 22d, and the day following, at noon, they again sailed, and were shortly after moored off the dock-yard at Deptford. As they passed along to their destination, they were hailed with demonstrations of welcome by the multitude that lined the shore.

The loss of men during the voyage consisted of five in the two years and a half. The first two died in the Fury in 1822, and were consigned to one grave. A sailor of the Hecla shortly after lost his life by falling from the mast; another sailor died of dysentery in the same vessel; and Mr Fyffe, the master, died of scurvy while on the passage home.

It is to be hoped that the expedition in which the same able commander is now (1825) engaged, will be productive of further discovery in the polar regions. Captain Franklin has again set out on an overland arctic expedition.

An extract of a letter, dated April 22, 1825, from Dr Richardson, is published in the number of the Edinburgh Philosophical Journal for July. It states, that exactly two months after Captain Franklin left London he arrived at Penetanguishene, on Lake Huron, from which place the letter is written, and which is the most advanced naval station on the lakes. "Our Canadian voyagers," he observes, "have arrived from Montreal, and we start to-morrow in two large canoes, and thirty-two of a party, for Fort-William, on Lake Superior." From the latter they were to proceed, in four canoes north, to Lake Winnipeg, and so on to Methye Portage, where they expected to overtake the boats that left England last summer.

For further information respecting the polar regions the reader is referred to the *Chronological History of Voyages into the Arctic Regions*; Ross's *Voyage of Discovery* made under the orders of the Admiralty, in his Majesty's ships Isabella and Alexander, for the purpose of exploring Baffin's Bay, and enquiring into the probability of a north-west passage; Fisher's *Journal of a Voyage of Discovery to the Arctic Regions*; Parry's *Journal of a Voyage for the Discovery of a North-West Passage from the Atlantic to the Pacific*, performed in the years 1819-20, in his Majesty's ships Hecla and Griper; Scoresby's *Journal of a Voyage to the Northern Whale Fishery*; Parry's *Second Voyage*, performed in the years 1821-

22-23, in the Fury and Hecla; Franklin's *Narrative, in the Quarterly Review,* Vol. XVIII.

POLAR REGIONS, those parts of the world which lie near the south and north poles. The poles are those points on which the terraqueous globe turns; each of them being 90 degrees distant from the equator, and, owing to their situation, the inclination of the earth's axis, and its parallelism during the annual motion of our globe round the sun, have only one day and one night throughout the year, each about 182½ days long. In consequence of the obliquity with which the sun's rays fall upon the poles, and the great length of winter, at night these regions are intensely cold, and have never been fully explored, and whether they consist of land or water, is not precisely ascertained. See POLAR EXPEDITIONS.

POLARITY, a term signifying tendency to the pole, and used to denote that quality by which certain substances are attracted to, or repelled from the pole of some circle. See MAGNETISM.

POLE, REGINALD, a celebrated cardinal, was born in Staffordshire, in the year 1500. Having acquired the rudiments of education in a Carthusian monastery near Richmond in Surry, he was in his twelfth year sent to Magdalene college, Oxford, where he prosecuted his studies with ardour, and soon obtained the degree of batchelor of arts. He was made prebendary of Salisbury in 1517, and afterwards dean of Wimborne and of Exeter. In his nineteenth year he went to Padua in Italy, where he made considerable progress in learning; and returning to England in 1525, he received a most flattering reception at court, where he was held in the highest estimation for his admirable talents and address. The pleasures of a court, however, were not relished by him, and preferring a life of study, he retired to a Carthusian convent, where he remained about two years. When Henry VIII. began to divulge his scruples relative to his marriage with Catherine of Spain, Pole, with the view of avoiding the difficulties to which he foresaw this affair would unavoidably expose him if he remained at home, determined to quit the kingdom; and, accordingly, obtained permission to visit France and Italy. Henry now divorced Catherine and married Ann Boleyn, and resolving to renounce the pope's authority, commanded Dr Richard Sampson to write a book in justification of his conduct, to which book, Pole, while in Italy, wrote an answer, which proved most offensive to the king, who stripped him of all his preferments, and procured an act of attainder to be passed against him. He, however, enjoyed the pope's protection, who made him a cardinal, and sent him to different parts of Europe in the capacity of nuncio. Being afterwards appointed legate at Viterbo, he remained there till 1543, when he became legate at the council of Trent, and was employed by the pope as his chief counsellor. After the death of Pope Paul III., Pole retired to the convent of Magazune, near Verona, and continued there till 1553, in which year he was sent legate to England. On his arrival at Whitehall, he was received with every mark of respect, and was conducted to the archbishop's palace at Lambeth, which had been splendidly fitted up for his reception. Pole now succeeded in restoring the pope's authority, and made his public entry into London with great solemnity, in order to commence the extirpation of heresy.

Cardinal Pole afterwards obtained the full management of ecclesiastical affairs in England, and shewed himself the inveterate enemy of the reformed. The day after the execution of Cranmer, he was consecrated archbishop of Canterbury; and shortly after he was appointed chancellor of Oxford and Cambridge, both of which he visited by his commissioners. He died in 1558 in the 58th year of his age, and his remains were interred on the north side of Thomas à Becket's chapel.

The Romish writers are lavish in the praise of Pole, to whom they ascribe every virtue. It is said that he advised moderate measures with respect to the Protestants. But, from authentic records, it is evident, that, from the time of his obtaining the management of ecclesiastical affairs in England, the persecution became more violent, and the executions more frequent. He unquestionably was an over zealous member of the Romish church, though he was perhaps a man of real worth and of mild manners. Besides his *Pro Unitate Ecclesiastica,* to which we have alluded, he wrote a Treatise on Justification, and some other tracts.

POLES, the extremities of the earth's axis, one of which is called the Arctic or north pole, and the other the Antarctic or south pole. See ASTRONOMY, GEOGRAPHY, and MAGNETISM.

POLICY, a contract whereby an insurance-broker, in consideration of being paid a certain sum per cent. according to the risk run, becomes bound to make good the loss of ships, merchandize, houses, &c. which may happen from storms, conflagration, and other causes. Policies of insurance of houses, lives, &c. are formed on the model of that for vessels. See INSURANCE.

POLIDORO, DA CARAVAGGIO, a celebrated painter, born at Caravaggio, in the Milanese, in 1492, and died at Messina in 1543. He practised the chiaroscuro in a very superior degree, and finished a great number of pictures in fresco and in oil for the public buildings at Rome. See DESIGN.

POLITICAL ECONOMY is the name applied to an important division of the science of government. See ECONOMY POLITICAL.

POLO-MARCO, or MARK PAUL, a celebrated traveller, was the son of Nicholas Polo, a Venetian, who, in the early part of the thirteenth century, went with his brother Matthew to Constantinople, and, in the course of his travels, was introduced to the court of Kublai, grand khan of the Tartars. Having acquired a knowledge of the different dialects of Tartary, Mark was employed in embassies which afforded him an opportunity of traversing Tartary, China, and other eastern countries. About the year 1295, he served his country at sea against the Genoese, by whom he was taken prisoner and carried to Genoa, where he remained in confinement many years, and composed the history of his own and his father's voyages under this title, *Delle maraviglie del mondo da lui vidute,* &c. This curious work was first printed at Venice in 1496. The writings of this traveller communicated much important information mingled with a great deal of the marvellous. respecting India and China, which were then very little known to Europeans.

POLYBIUS, a celebrated Greek historian, son of Lycortas, a praetor of the Achæan republic, born about 203 years before the Christian aera, at Megalopolis in Arcadia. Educated both as a soldier and a statesman from his earliest years, he rose to great distinction in consequence of the part he acted in the negociation with Ptolemy Epiphanes, and in various engagements with the Romans in Macedonia. Scipio and Fabius valued him highly both for his bravery and his learning. When Persius was conquered, he was carried prisoner to Rome, where he continued for 17 years, and, instead of returning to witness the degradation of his country, he preferred going into Africa with Scipio Emilianus, where he distinguished himself at the taking of Carthage and Numantia. Having returned to his native place after the death of his friend Scipio, he lived there highly respected and esteemed, till, at the age of 82, he died in consequence of a fall from his horse. His history of the Punic war, in 38 books, comprehending a space of 53 years, is a valuable work. He likewise wrote an Epitome of Roman History, from the taking of Rome by the Gauls, five books of which only have been preserved entire, together with fragments of twelve more. There are several editions of his works, the best of which are that of Gronovius, Amsterdam, 1670, and that of Schweighaeuser, 7 vols. 8vo, Leipsic, 1785.

POLYCARP, one of the most ancient fathers of the Christian church, and a disciple of St John the Evangelist, is supposed to have been a native of Smyrna, and was born during the reign of Nero. He was first a deacon and catechist, and afterwards bishop of the church, in his native city. According to some, he is the angel of the church of Smyrna, spoken of in the second chapter of Revelation. In consequence of a violent controversy between the eastern and western churches respecting the time of the celebration of Easter, Polycarp undertook a voyage to Rome, with the view of having a friendly conference with the bishop of that city. During his abode there, he combated various heresies that had sprung up, and was successful in promoting the purity of the Christian faith. After a long and faithful discharge of ministerial duty, this distinguished individual sealed the truth of his doctrines with his blood; he suffered martyrdom under Marcus Aurelius. Of his works, only his homily to the Philippians is extant, a work of great value for establishing the authenticity of several books in the New Testament.

POLYGAMY, a term derived from two Greek words, signifying *many* and *to marry,* and denoting a plurality of wives. The custom of marrying more than one wife is prohibited in all Christian countries. It was permitted among the Hebrews; and it exists among the various religious sects that have prevailed in Asia. Among the Romans, Mark Antony was the first who took the liberty of having two wives, and polygamy afterwards became pretty frequent, till the reigns of Theodosius, Honorius, and Arcadius, who prohibited it by express law; but it was afterwards permitted by the Emperor Valentinian. Polygamy is differently punished in Germany, Holland, and Spain. By a constitution of Charles V. this offence became a capital crime. In Sweden it is punished with death. In Scotland it is punished as perjury; and in England it is enacted, by statute 1 Jac. I. cap. 2. that if any person being married do afterwards marry again, the former husband or wife being alive, it is felony, but within the benefit of clergy, in which case the first wife shall not be admitted as an evidence against her husband, because she is the true wife, but the second may, for she is indeed no wife at all; and so *vice versa* of a second husband.

POLYGLOTT is the name given to a Bible printed in several languages. The first Bible of this kind was that printed by Cardinal Ximenes in 1517, containing the Hebrew text, Chaldee Paraphrase on the Pentateuch, the Greek version of the seventy, and the ancient Latin version. Many others of the same kind succeeded, as Plautin's Polyglott Bible in Hebrew, Chaldee, Greek, and Latin, with the version of the New Testament in Syriac; M. le Joy's Bible, in Hebrew, Samaritan, Chaldee, Greek, Syriac, Latin, and Arabic, with several other oriental versions and various readings. See *Scriptures* under RELIGION.

POLYGNOTUS, a celebrated painter, of Thasos, who flourished about 422 years before the Christian era, and was held in such high estimation for his paintings among the Athenians, that the Amphictyonic counsel, which consisted of the representatives of the chief cities of Greece ordered that wherever he went he should be maintained at the public expense.

POLYGON, a figure whose perimeter consists of more than four sides. See MATHEMATICS.

POLYGRAPH is a machine for taking several copies of a piece of writing at once.

POLYNESIA comprehends the extensive tract of Asiatic islands in the Pacific ocean; which islands lie between the meridian of 130° east and 120° west longitude, and between 25° north and 32° south latitude. Those of them in the North Pacific, are the *Pelew islands*, the *Ladrones,* the *Caroline islands*, or New Philippine islands, and the *Sandwich islands*. Those in the Southern Pacific are the Marquesas, the Society islands, and the Friendly islands.

POLYPHEMUS, in fabulous history, the renowned Cyclops, son of Neptune and Thoossa, the daughter of Phorcys. This monster had but one eye in his forehead, was possessed of immense strength, and was very tall, subsisted on human flesh, and herded his flocks on the Sicilian coasts. When Ulysses was returning from the Trojan war, he and twelve of his companions having landed upon the coast, were seized by this monster, who confined them in a cave, and devoured two of them daily; but the crafty Ulysses, while he amused the monster by telling the story of the siege of Troy, got him intoxicated, and when he was asleep, put out his eye with a firebrand. Awakening with violent pain, Polyphemus suddenly shut the mouth of his cave; but Ulysses, by creeping between the legs of the rams, as the Cyclops led them out to feed, effected his escape.

POLYTHEISM, the acknowledgement and wor-

Polytheism.

Pomegranate || Pomœrium.

ship of more gods than one. Philosophers have disputed whether men possess originally that faculty which is denominated the moral sense. A similar dispute has been carried on in regard to religion; some maintaining that a sense of Deity belongs to the whole human race, while others deny it. The question is accompanied with many difficulties; but it is not our intention to enter into the examination of it, as it will be considered under the article Religion. This, at least, may be presumed with safety, that revelation is the original source of accurate knowledge of the object of worship; and that communications were made to men as often as they forgot this object. To this statement the Scriptures add their sanction. Reasoning from what we perceive in the material universe, the wonderful adaptation of things to particular ends, the unity of design apparent throughout the whole, and the regular movements of every part of the machine, we infer pure theism, not polytheism, to have been the primeval religion of man. Men, in general, are not in the habit of thinking accurately and deeply, know so little of the nature and character of invisible beings, form all their conceptions from material objects, and so are apt to clothe the objects of belief in material forms in order to make a more deep and lasting impression on the mind. The phenomena in the world of matter have inspired the mind with superstitious fears, and led to various means to quiet them, according to the character of the feelings excited at the moment. Thus, on the first principle, we account for the gradual introduction of the worship of material objects, on pretence, at first, of preserving reverence for the Supreme Being, but ultimately, in fact, transferred to the objects themselves; and, on the second, we account for the innumerable order of deities created by the foregoing apprehensions. An ancient sage thus states his view of the origin of polytheism: "Our powers are confined within narrow limits; we do not readily conceive powers in the Deity much more extensive; and we supply by numbers what is wanting in power." If this view be correct, its universality, both among the civilized and barbarous nations of antiquity, excites no surprise. It is generally supposed that the worship of the sun, moon, stars, and other heavenly bodies, was the first system of idolatry. Superstition rioted in the fictions of fancy, and this introduced the worship of men who had proved benefactors to their kind, or been celebrated in any particular sphere of society,—in arms, legislation, arts, and sciences; and the social character of polytheism increased the number of these deified heroes to such an extent, that when Christ appeared to overturn all these systems, they could not be calculated. Animals of various kinds, reptiles, and vegetables, became objects of reverence and esteem, and found their places in Pagan idolatry, especially in Egypt, so long noted for astronomical and general science. So ineffectual was learning to cure these delusions, that altars were erected in honour of abstract principles and feelings of the human breast; even the basest of the selfish and malignant passions had their share of exaltation. Human folly never appeared so great as in the invention of divinities. The votaries of philosophy, whatever their sober senses might at times dictate, yielded to the general custom; and in the case of Socrates and many others, polytheism found encouragement. All this, founded on historical facts which cannot be denied, prove the weakness of human reason even when highly cultivated, and the advantages we derive from revealed religion. See Religion; Kames's *Sketches of the History of Man*, Vol. III.; Sir William Jones's *Asiatic Researches*.

POMEGRANATE, a tree, of which there are two species. The Punica Granata, or common pomegranate, rises with a tree stem, branching numerously all the way from the bottom, growing to the height of 18 or 20 feet, with spear-shaped narrow opposite leaves, and the branches terminated by large red flowers succeeded by roundish fruit, as large as an orange, having a hard rind filled with soft pulp and numerous seeds: Of this species there is a variety with beautiful double flowers, and another with stripe flowers. The Punica Anan, or dwarf American pomegranate, rises with a shrubby stem branching four or five feet high, with narrow short leaves, and small red flowers, succeeded by small fruit; begins flowering in June, and continues till October.

POMERANIA, a province in the circle of Upper Saxony in Germany, but at present belonging to Prussia, situated on the south coast of the Baltic, extending in length above 200 miles, and varying in breadth from 50 to 80 miles. This country is flat, the soil light; the climate is cold, and the atmosphere for the most part foggy.

Many fine rivers water the vallies, the most considerable of which are the Nega, the Oder, the Persant, the Vipper, the Pene, the Lobo, and the Stolp, besides several other inferior streams. It likewise contains numerous and extensive lakes, and in its waters are to be found a great variety of excellent fish. Pomerania is clothed with woods and forests, which abound with fine timber, and along its coasts are several large and convenient harbours. The exports consist of corn, cattle, timber, wool, wax, and dried fish; the imports consist of sugar, coffee, and cotton. This province is divided into Hither and Farther Pomerania, and extends from E. Long. 12 to 18. from N. Lat. 52 to 54. See Prussia and Sweden.

POMET, Peter, a celebrated French druggist, born in 1658, and died 1699. He collected drugs from all countries; and his *Histoire Generale des Drouges* is considered a most complete work on the subject.

POMFRET, John, an English poet, of whom Dr Johnson remarks, "He pleases many, and he who pleases many must have merit." He was born in 1667 at Luton in Bedfordshire, of which place his father was rector. After prosecuting his studies at Cambridge he entered into holy orders, and was presented to the living of Malden in Bedfordshire. He died at London of the small-pox in the 35th year of his age. His poem entitled the *Choice* is generally admired.

POMŒRIUM, in Roman antiquity, was that space of ground, both within and without the walls, on which, from its being consecrated by the augurs, no buildings were permitted to be raised. Of the ceremony of drawing the pomœrium at the first building of cities, we have the following account by Plutarch, in which he is to be understood as speaking of Rome. "They dug a trench, and threw into it the first fruits of all things, either good by custom or necessary by nature; and every man taking a small turf of earth of the country from whence he came, they cast them in promiscuously. Then making this trench their centre, they described the city in a circle round it. After this the founder, yoking a bull and cow together, ploughed a deep furrow, with a brazen ploughshare, round the bounds. The attendants took care that all the clods fell inwards, *i. e.* towards the city. This furrow they called pomærium, and built the wall upon it.

POMONA. See the Article ORKNEY.

POMONA, in fabulous history, the tutelar deity of orchards and fruit trees. See VERTUMNUS.

POMPEII, an ancient city of Italy, near Mount Vesuvius, and about 15 miles from Naples, destroyed, with Herculaneum, by an eruption of that mountain in the year 79, and almost forgotten till the middle of the 18th century, when the ruins were discovered.

When Pompeii was first discovered under the mass of lava in which it was buried, considerable doubts were entertained whether it was really that city; but these doubts were speedily set at rest by the circumstance of the name being observed inscribed over the gate-way. The first object that presented itself to the astonished spectators, on entering this subterraneous city, was a fine square with arcades, supposed to be the quarter of the soldiers, from the number of military weapons found there. Adjoining to this square was a long narrow street adorned with shops, and in which each house had a court, and the streets were paved, like the Appian way, with stones of a foot and a half or two feet long. Several of the apartments within were ornamented with paintings *al fresco*, the colours of which were perfectly fresh and uninjured. In the streets, and around the city, were found innumerable skeletons, many of them with spades in their hands,—probably the remains of individuals who had been endeavouring to clear away the burning lava with which they were at length overwhelmed. At a small distance from the city was observed a very beautiful ancient villa, the floors of which were composed of tesselated marble, and which, when polished, might be mistaken for painting. In the cellar of this house were discovered the remains of no less than 29 persons, who, it may be conjectured, had fled hither for safety and protection. Among the ruins were found spoons, but no forks, from which it has been conjectured that forks were not known till about the year 1000.

Among the ruins of this ancient city were a great variety of valuable manuscripts, a considerable number of which have, with great care and labour, been unrolled and transcribed, and six volumes of the Papyri have long since reached London, which were presented to George IV. when Prince of Wales, by the King of Naples.

Pompeii, together with Herculaneum, were first overthrown by a violent earthquake, but in the ninth year of the reign of Nero they were both consigned at once to complete oblivion, by the dreadful eruption of Vesuvius, when the latter was buried under a vast mass of volcanic matter, 24 feet deep, but the former not so deep by one half, being farther distant from the burning mountain. During the long period of 1634 years these two cities lay concealed. In 1713 some labourers digging a well, struck upon a statue in the theatre of Herculaneum, and about forty years after this period, Pompeii was likewise discovered and excavated, when about 500 MSS. were obtained from both.

The MSS. are unrolled or developed by means of a frame, which consists of several taper and oblong pieces of wood with parallel threads of silk on each side; and when this frame is placed upon any volume each piece of wood must be fixed precisely over each line of the page, while the respective threads being worked beneath each line, and assisted by the corresponding piece of wood, raise the line upwards, and disclose the characters to view. The fruits of this operation have been one publication on music by the celebrated Philodemus, and another on cookery; and from the great number of MSS. already procured, there is reason to hope that many others of the most celebrated writers of antiquity will yet be recovered which formerly were considered as entirely lost. As these two cities, which contained public theatres, and every thing attendant on opulence, splendour, and a crowded population, were the elegant and favourite resorts of the most distinguished Romans for wealth, luxury, and science, there is reason to hope that the operation of unrolling and transcribing the MSS. will yet discover many ancient works that have been buried in oblivion, in which case the labours of those engaged in the business will be attended with brilliant success. For further information concerning Pompeii, see Watkins' *Tour through Switzerland, Italy, &c.*; Swinburn's *Travels in the two Sicilies*; Captain Sutherland's *Tour up the Straits, &c.*; Dr Smith's *Sketch of a Tour on the Continent* 1786-87; and Lady Millar's *Letters*.

POMPEY THE GREAT, a brave general, the distinguished opponent of Cæsar, and whose ambition led to his country's slavery, was born in the 647th year after the building of Rome. When very young he served under his father, and was the means of preventing his assassination, for the execution of which bribes were used by the leader of the opposite party. At the age of 23 he joined Sylla with some of his father's veteran troops, and contributed much to his success against Marius. Sylla employed him in various expeditions, especially to Africa, where he added so much to the limits of the Roman power, and the splendour of their arms, that he was honoured with the title of Great. Soon after the death of Sylla, he was elected consul, although only 36 years of age, in which office he greatly distinguished himself by putting an end to piratic plunders in the Mediterranean, and subduing Mithridates and Tigranes, two formidable princes in Asia, thus adding Pontus, Bithynia, and Syria to the empire; and for these exploits a triumph was decreed him for two days. Pompey, Crassus, and Cæsar next formed what is called the Triumvirate; a combination that paved the way for those civil commotions which proved fatal to the cause of freedom, and even to Pompey himself. After the death of Crassus, and Julia, his wife, who was the daughter of Cæsar, the jealousies which had long lodged in the breasts of these distinguished individuals, broke out, and terminated in a civil war. For all this, various causes have been assigned; but the most probable one is, that they were envious of one another's reputation. Had Pompey distinguished himself with his usual skill, opportunities occurred of cutting off Cæsar; but urged on by the importunity of his troops to risk without any necessity a general engagement, he was completely defeated on the plains of Pharsalia; after which, having attempted to land on the coast of Egypt, he was basely assassinated in the 59th year of his age. See Rome.

POMPEY'S PILLAR, a celebrated column, which we have already described under Alexandria. Much curious information respecting this interesting monument of antiquity is contained in Clarke's Travels, Vol. III. p. 254-270. See also Pococke's *Description of the East*, Vol. I. p. 8.; Hamilton's *Egyptiaca*, Lond. 1809; Norden's *Travels in Egypt*, Vol. I. and Brotier's *Annot. in Tacit. Hist.* Lib. iv.

POMPONATIUS, Peter, an Italian philosopher, who is said to have applied himself so very intensely to the solution of difficulties, that he frequently forgot to eat, drink, sleep, and perform the ordinary functions of nature. He was born at Mantua in 1462, and is supposed to have died in 1525, in the 63d year of his age. He taught philosophy first at Padua, and afterwards at Bologna, and was the author of *De Immortalitate Animæ*, wherein it is maintained that the immortality of the soul cannot be proved by philosophical reasons, but is to be believed as an article of faith. Pomponatius was remarkably small in stature, yet such were his talents and acquirements, that he was considered one of the greatest philosophers of his time.

PONDICHERRY, *Puducheri*, a large town of Hindostan, in the Carnatic, and the capital of the French settlements in India. See Hindostan.

PONG-HOU, a cluster of islands situated between the port of Emouy and the island of Formosa, in east long. 121° 25′, and north lat. 25° 30′. Though these islands are only sand-banks or rocks, with very few inhabitants, they are of consequence to Formosa, which has no port capable of receiving vessels that draw above eight feet of water. The harbour is good, and was fortified by the Dutch while they were masters of Formosa. At Pong-hou there is a Chinese garrison, with one of the mandarins called Literati, whose duty it is to watch the trading vessels that pass between China and the island of Formosa.

PONIARD, a sharp-edged instrument of offence, which was anciently much in use, and was carried in the hand or at the girdle, or hid in the pocket. Among the Spaniards, sword and poniard are said to be the arms of duellists; and the practice of sword and poniard is a branch taught by the masters of defence.

PONT ST ESPRIT, a town of France, in the department of Gard, situated on the Rhone, is chiefly celebrated for its bridge, which is built in a curve, and is one of the finest in France. It is about 3000 feet in length, and consists of 19 great and seven small arches. Apertures are made through each pier to facilitate the passage of the water when the Rhone is high. The town, though large, is not well built, and the streets are crooked and gloomy. The inhabitants are estimated at 4100; and some silk manufactures are carried on. Pont St Esprit is 17 miles south of Viviers, and 55 north-east of Montpelier.

PONTEFRACT, or Pomfret, a borough and market-town in the west-riding of Yorkshire, is situated in a very rich soil, near the river Aire, and consists of three principal streets, nearly parallel, which are intersected by smaller ones. It is a handsome well-built town, and is governed by a mayor, recorder, and twelve aldermen, and sends two members to Parliament. Here are places of worship for the Methodists, Roman Catholics, Quakers, and other dissenters; likewise a free grammar school, endowed by Edward VI. The castle of Pontefract, a small portion of which still exists, has been the scene of various tragical events in the English history, particularly the murder of Richard II. This place is noted chiefly for its extensive nursery-grounds, large plantations of liquorice, and its great horse fairs. It has a considerable trade; and the population of the borough and township was, in 1821, estimated at 4447. Races are annually observed at Pontefract; where also the accounts are every year made up of all the cloths fulled at the various fulling mills in the west-riding.

PONTIFF, or High Priest, a person who superintends and directs religious solemnities. The Roman catholics style the pope the sovereign pontiff. Among the Romans there was a college of pontiffs, whose office was to assist the high priest in giving judgment in all causes relating to religion,—inquiring into the lives and manners of the inferior priests, and punishing them, if they saw reason. Numa instituted over the college of pontiffs a sovereign pontiff or pontifex maximus, whose function was to prescribe the ceremonies for the worship of each god, compose the rituals, direct the festivals, and perform the business of augury.

PONTINE LAKE, a lake of Italy in the country of the Volsci, through which passed the great Appian road. Along the canal that ran from Appii Forum to Terracinae, travellers were conveyed in boats drawn by mules. The air had become so noxious from its stagnant waters, that travellers had long avoided passing near it, till an attempt was made by Pope Pius VI. to drain the lake and the marshes.

PONTON, or Pontoon, in war, a floating bridge, of sufficient strength for horse and cannon to pass over. It is made of two great boats, placed at some distance from one another, both planked over, as is the interval between them, with rails on their sides. The same term applies to a kind of flat-bottomed boat, lined within and without with tin or copper, which serves the purpose of laying bridges over rivers for the artillery and army to pass over. A pontoon carriage is made with two wheels and two long side pieces, whose fore ends are supported by a limber, and serves to carry the pontoon, boards, cross-timbers, anchors, and other things for making a bridge.

PONTOPPIDAN, Erick, a Danish divine, born in 1616, and died in 1678. He became bishop of Drontheim in Norway, and published a grammar of the Danish language, and some other learned works.

The Danish historian of the same name was his grand-nephew, and was bishop of Bergen in Norway. He was the author of several works, particularly a history of Norway, and a history of the reformation in Denmark.

PONTUS, an extensive country of Asia Minor, which lies between the 21st and 23d degree of north latitude, and is bounded on the east by Colchis, on the west by Halys, on the south by Armenia Minor, and on the north by the Euxine sea.

The learned Bochart and others derive the name from a Phœnician word, signifying a filberd, a species of nut very abundant in that country; some from a king called Pontus, and others from the Euxine sea, commonly called Pontus Euxinus. The original inhabitants of this kingdom are supposed to have been the descendants of Tubal, one of the sons of Japheth; but, in the progress of time, colonies from various parts emigrated here, and were incorporated with the natives. The kings of Media and Persia were the ancient sovereigns of this country. Darius Hystaspes erected it into an independent kingdom, and conferred the chief power on his son Artabazes, 486 B. C. It maintained its independence till subdued by Alexander the Great: but this was not of long continuance; for, in consequence of the disputes among his generals, Mithridates II. recovered his dominions, which were afterwards enlarged by his successors. The most distinguished of the kings of Pontus was Mithridates VII. surnamed the Great, well known for his long opposition to the power of Rome. As soon as he ascended the throne, he aimed at the government of all Asia, and, in order to ascertain the character and strength of the various nations journeyed through them; and inured himself to toils, hardships, and exercises of different kinds, that he might better qualify himself for military fame. He began his career of ambition by invading Paphlagonia, Galatia, and Cappadocia; but they being unable to oppose him, pleaded the protection of the Romans. The Romans accordingly took up their cause, and ordered Mithridates to relinquish his claim, as they had declared these states to be free; but being flushed with success, instead of submitting, he overran all Asia, invaded Greece, and even meditated to carry his arms into Italy. He tarnished his victories by excessive cruelties towards those Romans who fell into his hands, and whom he ordered to be massacred. This provoked the Romans to commence hostilities in greater earnest, by sending Sylla to Greece, who immediately arrested his progress, and, after many signal defeats, compelled him to sue for peace on the most disadvantageous terms. No adverse fortune, however, could humble him, for his restless ambition afforded pretexts for two wars in succession, in which he was defeated by Pompey the Great. Being at last deserted by his allies and betrayed by his son Pharnaces, he, disdaining to grace a Roman triumph, attempted his death by poison, which proving ineffectual, he with some difficulty prevailed on a Gaul to dispatch him. After his death Pontus became a province of the Roman empire, 63 B. C.—Mark Antony, after the battle of Philippi, gave the sovereignty first to Darius and afterwards to Palemon; but Nero once more made it a province of Rome, which it continued to be till 1204, when David and Alexis Comnenus were driven from Constantinople by the French and Venetians. Alexis Comnenus erected a new empire, including most of Pontus, which was held by his descendants till A. D. 1462, when it was joined to that of Constantinople.

PONTYPOOL, or Pint-ap-Howell, a small town of Monmouthshire, situated in the river Avon. It consists of one street running east and west, intersected by two smaller ones, and its numerous shops give it a thriving appearance. It derives its importance from the coals and iron that abound in its neighbourhood, and from its iron and tin-works and extensive manufactory of japan ware. In 1821 the population of the parish of Trevetham and township of Pontypool was estimated at 3930. A canal communicating with Newport has been formed close to the town.

PONZA or Pontia, a small island in the Tuscan sea, on the east coast of Italy near Terracina, is about five miles in length, but the greatest breadth does not exceed half a mile. It is surrounded by a number of rocks chiefly composed of lava. The harbour is a quarter of a mile in width, with a mole at the extremity, and capable of containing many large vessels. The population is about 800, and the chief trade is in salt. Ponza derives considerable celebrity from its having been the place to which many illustrious Romans were anciently banished. It is the mere skeleton of a volcanic island, whose hard and vitrified parts are slowly mouldering away; and it is still subject to violent earthquakes. Ponza is surrounded by other small islands named Palmarole, Zannone, &c. It was visited by Sir William Hamilton in 1785.

POOLE, a sea-port and walled town of Dorsetshire. It is governed by a mayor, senior bailiff, four justices, and a considerable number of burgesses. Its streets are spacious, and it contains a church and about 600 houses; has a large manufactory of knit hose, and sends two members to Parliament. See Dorsetshire.

POOLE, Matthew, a learned writer, who was a native of York, and flourished in the 17th century, prosecuted his studies at Emmanuel college, Cambridge, and at the university of Oxford, and afterwards succeeded to the rectory of St Michael de Quern in London, but was ejected from his living in 1662 for non-conformity. Besides his great work, *Synopsis Criticorum*, &c. which occupied his attention for ten years, he was the author of several other pieces. He died in Holland in 1679, and left behind him the character of an able critic and casuist.

POONAH, a town of Hindostan in the province of Bijapoor, and the capital of the Peshwa and of the Mahratta empire. See Hindostan.

# POOR.

Causes of Pauperism.

POOR, those who by their own labour are unable to support themselves, or, in a more strict and legal sense, those in a state of *indigence*, and who are chargeable to the parish. The term is applicable to such as, from unavoidable calamity, age, or sickness, are rendered incapable of procuring subsistence by any honest exertion or endeavour of their own, and who, therefore, have a reasonable claim to relief upon the possessors of property, founded not only on the great law of nature, and sanctioned by Christianity, but also consistent with the rights of property and the law of the land.

After what has already been said under ECONOMY POLITICAL, on the subject of poor rates in England, and the means of checking the progress of pauperism, we should have deemed it unnecessary to add any thing more, were it not that the proper maintenance of the poor is a matter of great and paramount importance not only to the poor themselves, but likewise to the welfare and prosperity of every government. In our enquiries upon this subject, we shall therefore consider, 1st, The causes of pauperism; 2d, The various modes adopted for its relief; 3d, The nature of the English and Scotch poor laws, and whether they be founded on the principles of natural right; 4th, What is the most eligible plan for the maintenance and relief of the poor.

1. *Causes of pauperism.*—On this subject several authors of great reputation have entertained different sentiments; and, of late years, an opinion has become very prevalent, that every system of poor laws, however perfect, is injurious rather than beneficial, and that the tendency of such laws is to increase the evil they profess to remedy. Indeed, it has by many been unhesitatingly asserted, that the operation of poor laws is the chief if not the sole cause of pauperism, and that the true and effectual remedy for this evil is the total abolition of all provision for the helpless and indigent. Of this opinion is Mr Malthus, and even Dr Chalmers, whose knowledge on this subject is so extensive and accurate. The admirable and truly benevolent plans which he has adopted for restraining the progress of pauperism, have rendered him worthy of the general gratitude of mankind, although assuredly he has attributed to poor laws a greater influence in the production of pauperism than they ought in reality to be charged with.

The earliest writers on political economy have ascribed this evil to causes of a very different nature. By some it has been attributed to the dissolution of the monasteries in the reign of Henry VIII. on which account it became necessary for Queen Elizabeth to make a legal provision for the indigent, who had been perhaps too amply relieved by the charity of the monks. Whilst the convents remained, Dugdale observes, that no act was passed or was necessary for the relief of the poor; whereas, immediately after their suppression, no less than eleven bills were brought into the House of Commons for their relief. But nearly about the same time, in several kingdoms throughout Europe, other provision for the poor became necessary, even where the monasteries were suffered to remain. It has, therefore, been inferred that the cause lay deeper, that the statute 43d of Elizabeth has been the work of ages, and was owing to some more general cause, whose influence had extended itself to many other countries.

Mr Alcock, therefore, ascribes this legislative measure, adopted by the English Parliament, to the depreciation of the precious metals, in consequence of the vast importation of gold and silver into Europe from Spanish America, which occasioned a rise in the price of commodities to the labourers, and produced the same effect as scarcity, or a succession of unproductive harvests, which, not being counteracted by a progressive rise of wages and demand for labour, must therefore have impaired the circumstances and comfort of the labouring classes, and, in time, reduced them to indigence and beggary. The Rev. Dr Davies, in his "Case of Labourers and Husbandry stated and considered," remarks, on the depreciation of the currency for several centuries, that the nominal price of day labour is at present only about four times, or at most five times, higher than it was in 1514. But the price of corn is seven times, and of flesh meat and raiment about fifteen times higher." This author states, that, about the middle of the 14th century, the ordinary price of day labour was twopence; a medium quarter of wheat 3s. 8d.; twenty days labour were equal to a fat hog two years old, and to clothing for a year to a servant of husbandry. Six days labour were equal to a quarter of beans, five to a quarter of barley, two to a pair of shoes, and one to two gallons of ale. Towards the latter part of the 18th century, the rate of labour in England was 14d., wheat 48s., malt 42s. 6d. per quarter, the first valued at 41 days labour, and the last at 36½; a quarter of beans at 27, of barley 20; a pair of men's shoes at 6; servants clothing for a-year 40 days; and for 3 lb. common cheese, or 1½ lb. butter, 1 day's labour. In Scotland, in 1124, a boll of wheat was valued at 10 and 12 pennies Scotch per boll, a flaggon of wine at 2 pennies, and a hen at a halfpenny; but in the time of David I. and long after, money was 36 times, in James I.'s reign 18 times, in James II.'s it was 9 times the value that the same denominations are at this day.

Others ascribe the progress of pauperism not merely to the increase of price in those commodities which are necessary for the comfortable maintenance of the labourer, but likewise to the change occasioned by the introduction of commerce and manufactures; and Sir F. Eden, in his State of the Poor, is of this opinion. "Without the most distant idea (says he) of disparaging the numberless benefits derived to this country from manufactures and commerce, the result of this investigation seems to lead to this inevitable conclusion, that manufactures and commerce are the true parents of our national poor,—and to justify the (by no means unreasonable or captious) opinion of those who think that it is particularly incumbent on persons engaged in manufactures and commerce to help to maintain them."

But there is still another cause which has been assigned for the introduction of pauperism, and perhaps the most important of any, although by most writers on this subject it has been entirely overlooked; and it is this,—that poverty, as a permanent condition, results chiefly if not solely from the moral degradation of mankind. This general depravity of the people limiting their desires and objects of ambition to mere bodily comforts and animal indulgences, renders them insensible to the influence of moral restraint, incapable of that foresight which should prompt them to provide for their future wants, and operates in the production of an excessive population. This cause of pauperism has been noticed in a small but excellent treatise on the law of Scotland relative to the poor, lately published by Alexander Dunlop, Esq. junior, advocate in Edinburgh. "The absence of intellectual cultivation," (he observes,) "as it confines the wants and desires of a people to the indulgence of their animal appetites, which in consequence they gratify without the check of any moral restraint, necessarily produces pauperism and wretchedness, by its tendency to increase the population of a country beyond the means of supply. On the other hand, an improved moral condition, resulting from religious and intellectual cultivation, by inspiring man with nobler desires and higher objects of ambition, raises him in the scale of humanity, and enables him to restrain the grosser propensities of his nature within those bounds which he sees to be necessary for the comfort, happiness, and respectability of himself and his family. Accordingly, in Scotland, pauperism decreased exactly in proportion as the inhabitants increased in moral improvement; and it has again augmented of late years, as the means of educating the lower orders of society have become inadequate, owing to the great increase of the population, especially in manufacturing towns. It is on the same principle that the deficiency of institutions for effectually educating the lower classes in England has been the true cause of the alarming extent of pauperism in that country, and of calling into such fearfully active operation, provisions of the legislature similar to those which have fallen into desuetude in Scotland, the effect of which again is to accelerate the moral degradation of the people, and the increase of pauperism. And it is owing to the almost total absence of any regular means of instructing the people, that Ireland has become a nation of paupers."

In illustration of this doctrine, we may farther remark, that while population increases under the want of moral cultivation, each generation becomes more indigent, thoughtless, and improvident than that which preceded it, till at last the people are reduced to such a condition, that their only aim is the attainment of the supply of those wants absolutely necessary to sustain animal life, which, when inadequate, puts a check to farther increase, by actual starvation, or by the diseases occasioned by famine. On the other hand, it is obvious, that the effect of intellectual and religious instruction is to inspire man with more elevated desires than those arising from his animal propensities. It enlarges the circle of his wants and the wish of satisfying them, communicates an ambition and a capacity for further advancement, and inspires him with a consequent pride in not only supporting himself, but his family also, from the degradation of allowing any of its members to become objects of common charity. Thus does the cultivated mind gradually acquire that character of prudence and foresight, and that conviction of the necessity of living under the influence of moral restraint, which affords to every rational being the most reasonable security against the danger of poverty. In illustration of this, it may be observed, that in Scotland, where the people are furnished with the best means of instruction, and where the powers granted by the legislature for a compulsory provision for the poor, are equally extensive with those granted for this purpose in England, pauperism is comparatively little known. It is only in about 150 parishes in Scotland that these powers have been put in execution; whereas, in England, where they have been called into the most active operation, pauperism, owing, it must be owned, in a great measure, to the mal-administration of the law, has increased to an alarming extent.

Such results are sufficient at once to demonstrate that the increase or diminution of pauperism is not in so great a degree affected by the character of the poor laws themselves, as by the proper or improper mode of their administration, and by the character and moral improvement of the people. A closer examination of the circumstances of the three kingdoms of the British empire will serve to illustrate and confirm the opinions already advanced as to the true cause of this great evil.

Shortly after the Reformation, when the system of poor laws was first established in Scotland, no country afforded a more hopeless prospect of recovering its inhabitants from the depths of pauperism into which they had fallen. Anarchy and turbulence reigned throughout the land,—the country was inundated by hordes of vagabonds, and neither commerce nor manufactures existed to give employment to the idle. England at that time excelled Scotland in every advantage arising from fertility of soil, from trade, commerce, and manufactures, and from all the arts of life that were calculated to yield employment and subsistence for its inhabitants. There was however one circumstance in favour of Scotland, which counterbalanced all the advantages possessed by England, and that was, *its institutions for the moral and religious instruction of the lower classes of the population*, and which inspired them with the feelings and sentiments, the prudence and foresight, already mentioned, and taught them this never to be forgotten maxim,—that every man ought to depend for his support upon his own industry, and upon his own resources. If the evil of pauperism then be less prevalent in Scotland than in England or Ireland, it must be *chiefly* attributed to the excellent adaptation of its ecclesiastical establishment, and the system of parochial schools, which have so admirably contributed to the moral and intellectual improvement of its inhabitants, rather than to the nature and superiority of its poor laws.

But besides these causes of pauperism already noticed, there is another to which few of the writers on political economy have ever adverted, occasioned by the fertility of the soil and the mildness of the climate in the southern kingdoms of Europe, and perhaps in a considerable degree in the mildest districts of Ireland. In such countries, the productions of the soil are almost spontaneous, very little accomodation is requisite for the shelter of the people, and a very scanty supply of clothing is adequate to the supply of all their wants. These causes must therefore operate in the production of a superabundant population, which must necessarily occasion wretchedness and poverty.

2. *Various modes adopted for the relief of Pauperism.*—To review the different modes that have been adopted for the relief of *indigence* in the various ages and conditions of civil society, will, to the generality of our readers, be perhaps no less instructive than amusing. The most common modes resorted to for the relief of indigence, as society increased, appear to have been *migration*, *colonization*, *agrarian laws*, and *domestic slavery*; and, in the farther progresss of improvement, *praedial servitude*, *monastic and other establishments* which were supported by *appropriate revenues*, *voluntary donations*, and *licensed mendicity*; and, last of all, *the revenues of the state*, by taxation or assessment in aid of voluntary charity.

The increase of population and establishment of property naturally tend to introduce inequality of condition, and along with it indigence, its never-failing concomitant. But in a country thinly peopled, and in which the inhabitants lead a pastoral life, the wants of the increasing multitude can be easily supplied, either by a more minute division of land, or by migration. These appear to have been the first remedies adopted for a superabundant population, among the Jews, who are the most ancient nation of which we have any authentic history. "And Abraham said to Lot, Let there be no strife, I pray thee, between thee and me, and between my herdsmen and thy herdsmen; for we be brethren. Is not the whole land before thee? Separate thyself I pray thee from me; if thou wilt take the left hand, then I will go to the right; or if thou depart to the right hand, then I will go to the left." In after ages, when the Jews inhabited Canaan and were greatly multiplied, the relief of the poor was reduced to a system, and enforced as a moral obligation. And as several of the provisions of the Jewish institutions are admirably adapted to the condition of other nations, and have actually formed the basis of other provisions for the poor in modern times, we shall give the outline of these laws, although they have never been considered obligatory unless upon the Jews in Canaan. By the Jewish code, each family had a certain allotment of entailed land, which might be mortgaged and redeemed, but could not be sold for ever, and to the possession of which the owner or the heir returned on the fiftieth year, being the year of jubilee, when, if unable to redeem his property, he was released of the payment of whatever sums might have been borrowed previous to that period. This law became a powerful check to extortion, as well as to poverty, and often converted the money lent into a species of charity. "The land shall not be sold for ever. If thy brother be waxen poor, and hath sold away some of his possession, and if any of his kin come to redeem it, then shall he redeem that which his brother sold. But if he be not able to restore it to him, then that which is sold shall remain in the hand of him that hath bought it until the year of jubilee; and on the jubilee it shall go out, and he shall return into his possession." Every seventh or sabbatical year was also a year of release to the poor. "At the end of every seven years thou shalt make a release, every creditor that lendeth ought to his neighbour shall release it; he shall not exact it of his neighbour, or of his brother, because it is the Lord's release, to the end that there be no poor among you." Such regulations were admirably calculated to prevent the increase of poverty; but for those who, notwithstanding, fell into a state of indigence, this admirable despensation made other ample provision, in several respects similar to some of the most ancient customs in Britain.

The *first fund* allotted for the maintenance of the poor, under the Jewish law, was the *corners of the fields*. "And when you reap the fields of your land, thou shalt not wholly reap the corners of thy fields." Under this precept the learned Selden includes every annual production, and the minimum of which amounted to a *sixtieth* part, which the poor could by law exact. The *second source* of provision was derived from the *gleanings of the harvest and vintage*. "Neither shalt thou gather any gleanings of thy harvest, neither shalt thou glean thy vineyard, and thou shalt not gather every grape of thy vineyard." This included every thing less than three stalks of corn, or clusters of grapes, as well as those of inferior quality. The *third source* of provision was *the forgotten fruits*, which were likewise appropriated for the same charitable purpose. "When thou cuttest down thy harvest in thy field, and hast forgot a sheaf in thy field, thou shalt not go again to fetch it." This also extended to grapes and all fruits. The fourth, and most valuable and productive source from which the poor derived provision, was *the tithe or tenth of every third year*. On the seventh or sabbatical year there was no crop, and the Jews consequently paid no tithe, seeing the spontaneous productions of the land were common to the poor and the rich. But in the other six years the Jews paid a double tithe, one to the Levites, and another, called the second tithe, upon the remaining nine parts, which last every third and sixth year belonged to the poor and the Levites. "At the end of three years thou shalt bring forth all the tithe of thine increase the same year, and shall lay it up within thy gates. And *the Levite*, (because he hath no inheritance with thee,) and *the stranger, and the fatherless, and the widow*, which are within thy gates, shall come and shall eat and be satisfied."

*Lastly*, among the other funds for the maintenance

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the poor, was *alms*. "Thou shalt not harden thy heart, nor shut thy hand from thy poor brother, but thou shalt open thy hand wide unto him, and shalt surely lend him sufficient to his need. Thou shalt surely give him, and thine heart shall not be grieved when thou givest unto him." Alms-giving was even *compulsory*, and could be enforced by the Magistrate, as the circumstances of the case might require. This appears not only from Mr Selden, but also from the Talmud itself. "Qui non voluit eleemosynam dare, aut minorem dederat quam erat ei par; cogebant eum judices fori seu synedrium, irrogata etiam poena verberum, quae contumacibus debita, usque dum id praestaret quod ipsi estimarent."—SELD.

Strangers, however, were not liable to these regulations, nor were alms ever received from heathens, except from princes and great men, and in cases of the most urgent necessity.

The Jewish law moreover particularly specifies the persons who were entitled to the benefit of these charitable funds, the "*fatherless, widow, and stranger*," under certain limitations. Those who had a certain sum laid out on trade, 12 sacred shekels, or 50 not in trade, could derive no benefit from these funds; and even to entitle a pauper to relief, he was obliged, first of all, to dispose of all his superfluous and valuable household furniture, and to be satisfied with what was of little value, and *strictly necessary*. Travellers whose money might be exhausted, were entitled to relief; and in the case of there being a sufficiency for all, the relief was extended even to heathen strangers. When the funds were inadequate, the Talmud gave a preference to the poor respectively, according to peculiar circumstances;—first to near relations, next to poor neighbours, and afterwards to those of the same city, the same country, or the same nation. But no individual, it may be observed, could ever be admitted to the benefit of these charities who did not use his *utmost endeavours* to contribute to his own support. By means of their own industry, together with the gleanings and the tithe, many of the poor contrived to make a comfortable subsistence, without requiring the aid of private charity.

In these venerable institutions, obviously may be found, many of those salutary regulations which constitute the foundation of the Scotch and English poor laws. The last mentioned fund, namely, *alms*, is a mode of relief common to the Jews and other ancient nations, to which, under the pressure of indigence, they have resorted in cases of urgent necessity. These were generally collected in weekly contributions on the Sabbath, and this practice was very early introduced into the Christian church. These alms were laid at the "Apostle's feet, and distribution was made to every man according as he had need." And as soon as Christianity was introduced into the Roman empire, the poor were indiscriminately supplied, and the most splendid hospitals were erected for the stranger, the fatherless, and the widow; which provision continued till the monasteries were suppressed.

When individuals had no other means of subsistence but their bodily strength, and when they found this inadequate for their support, they felt themselves compelled to exchange their labour and their liberty for the necessaries of life, and were thus reduced from a state of freedom to a state of slavery. This was a condition also recognised by the Jewish law, in which the children likewise followed the condition of their parents. The Jewish law, however, required that persons who had been reduced to poverty should be treated with the utmost lenity. "If thy brother that dwelleth by thee be waxen poor, and be sold unto thee, thou shalt not compel him to serve as a bond servant, but as an hired servant; and as a sojourner shall he be with thee, and shall serve thee unto the year of Jubilee."

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In the ancient states of Greece and Rome, the life of a slave was considered of little value. *Slaves*, therefore, were left entirely to the care and humanity of their masters. But *freed-men* who, by misfortune, had been reduced to want, were entitled to be maintained by *the state*. In Sparta, Athens, and Rome, *free-citizens* enjoyed the privilege of the common table, and had a share of the public property. But it was only after the strictest inquiries that they could obtain their ticket for the public distribution of corn, or the revenue of the state.

To remedy the evils of indigence, which are always combined with a superabundant population, savage nations have had recourse to the barbarous and revolting custom of *infanticide*. This detestable rite consisted in offering in sacrifice to the gods the human, animal, and vegetable produce of the year, in the *ver sacrum*, or consecrated season of spring—so that in time this became a superstitious or religious ceremony. When mankind became more civilized, this practice was changed, and *emigration* succeeded, so that the infants which were born during the year were consecrated and preserved till manhood, when, being provided with arms, they were sent forth to some other country to seek for a settlement; and to this custom many allusions have been made by the Greek and Roman poets. That this was a very ancient practice, is obvious, from what Strabo relates, and which we shall here transcribe. "In these regions, the Aborigines, after the expulsion of the Umbri, are reported to have made their first settlement. At first, indeed, a body of young men consecrated to the gods went forth, consisting of a few sent out by their parents in quest of sustenance, in conformity with an ancient custom which I know was in use both among the barbarians and Greeks. For when the cities of any people happened to receive any considerable increase of population, so as to render the domestic supplies of food no longer sufficient for the whole people, or when the land, damaged by the vicissitudes of weather, bore the accustomed produce in too scanty proportion, or when any other circumstance happening to the states, either of a prosperous or adverse nature, imposed a necessity of diminishing their number, then they dedicated to some deity a part of the population born within *a certain year*; and having furnished them with arms, dismissed them from their country." This author observes, that the emigrating party thus

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expatriated, when they found no asylum from others, secured to themselves a country either by amicable means or by conquest in war.

This superstition continued till the time of the Romans; and a similar plan for relieving the pressure of superabundant population was adopted by them, although, in some respects, considerably different. The Grecian states, deriving their support chiefly from a tax on foreign settlers, and from the revenues arising from the silver mines in the territory of Attica, sent forth their youth, without binding them to make any return of tribute to the mother country. Thus the more they reduced the number of citizens, in proportion did their revenues increase. But the Romans, in sending forth their superfluous population, had a view, not only to the support of the colony, but also required a portion of their acquired subsistence for the citizens who remained at home; and upon all their colonies, as well as upon the conquered nations, as they extended their dominion, they enforced the payment of the *Vectigal Annonae*, a tribute of corn, or the giving up a portion of their territory to be cultivated for the supply of the Roman citizens. When the Roman colonies had at length fully occupied the whole territory of Italy, and Rome had no other means of rewarding her victorious legions, she sent her soldiers to take forcible possession of the lands of the colonists themselves, to which practice the poet alludes, when he says, "Veteres migrate coloni, miles ait." By this glaring abuse of power, the supplies of the tributary corn of her subject provinces began gradually to diminish, and the imperial power terminated in revolt, famine, and poverty. To this state of matters, which may be considered as an exemplification of the agrarian law, succeeded the feudal system, when the only cultivators of the soil were slaves. In times of distress, it was by no means uncommon for freedmen to barter their liberty and that of their children for subsistence; but when Christianity was introduced, and slavery abolished, and when this vast multitude of slaves had no longer any master on whom to depend for subsistence, their claims for relief were necessarily transferred to the *state*, and provision was therefore made in all the *charitable and religious institutions* which were established in consequence of this great change. So early as 816, the Emperor Louis enacted, "That of the oblations to the church, two-thirds in rich situations, and one-half in lesser places, should be appropriated to the relief of the poor." As civilization and Christianity prevailed, similar enactments were introduced throughout Europe; and, besides these, private donations for the relief of indigence were, by the superstitious hopes and fears of the living, and still more of the dying, prodigiously increased. Thus, for a time, were the clamours of the indigent silenced, if not satisfied. But no sooner were these monastic institutions overthrown, than the miserable and idle multitude which had been accustomed to partake of the alms daily given at the gates of these religious houses, were dispersed, and necessarily became chargeable on the occupiers of the soil and others who had obtained possession of their lands and revenues.

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This violent convulsion, as might be expected, necessarily produced a series of enactments, till, under Henry VIII. mendicity was first legalised, but afterwards strictly prohibited and violently punished; and at length, in his statute 27. c. 25. a foundation was laid for the introduction of the present system of English poor laws. This statute enacts, "That the municipal officers should succour all poor people within their several districts, by way of voluntary and charitable alms, to be collected by them every Sunday and holiday, so that the poor, impotent, lame, feeble, sick, and diseased people, being not able to work, might be provided for, helpen, and relieved; and preachers, in their sermons, and at the times of confession, and of making wills, were to exhort persons to be charitable towards the relief of the poor and impotent, and for setting and keeping to work the able poor."

Precisely similar is the practice which prevailed in Scotland soon after the reformation, and which, with some slight alterations, has been persisted in to this present time. In consequence of the ancient custom and long continuance of praedial and feudal servitude and emigration, and in consequence of the pride of independence, and of the kindness and liberality of the poor to the poor themselves, comparatively few of the parishes of that kingdom have, as yet, resorted to compulsory assessment; and should ever the period arrive when this law must be generally adopted, the inhabitants of Scotland may boast of the wisdom of their forefathers which "invests the very persons who pay the tax with the right to inroll the paupers and modify the allowance."

*In France*, previous to the revolution, praedial servitude was not entirely abolished, and the poor were supported by voluntary alms, and by various munificent charitable institutions. Since that period, in consequence of the sale and distribution of the national lands to the lower orders at an inferior price, and of the privilege enjoyed, by the inhabitants of *communes*, of pasturing cattle after the removal of the crops, and upon wastes and communable lands, few demands have been made upon the charitable institutions. To maintain the poor, the National Convention proposed to unite all the charitable establishments of the kingdom, and for this purpose to dispose of all the property belonging to hospitals and other institutions of this kind; and till more than a half of this property had been actually so disposed of, they never discovered their error. Since that time the charitable institutions of France have been re-established, on funds arising—from the fixed property remaining after confiscation—from the *octrois municipaux, et de bienfaisance*, or taxes laid upon provisions and other commodities brought into large towns,—from a tax on tickets to public amusements,—from fines levied for certain offences,—from the *quetes*, or solicitations in churches,—from house to house,—from legacies and voluntary donations—and, last of all, from the public revenue. In aid of all these may be added, the *hospital, hospice*, and the *depots de mendicite*. The first comprehends the receptacles for casualties and sickness, the second those for the reception of the poor and impotent, and the last is designed to prevent public begging.

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In the city of Paris, a system of domiciliary relief was likewise organized in 1816, chiefly under the direction of M. Degerando, which cannot fail to be productive of the most beneficial result, and the outline of which is as follows.

"There are 12 offices, *bureaux*, under the direction of the prefect of the Seine and the general council of the hospitals; each office consists of a mayor of the arrondissement, of the clergy of all descriptions, Catholic and Protestant, and 12 other administrators named by government. Each arrondissement is divided into 12 quarters, and the administrators, assisted by the sisters of charity, take charge each specially of the several quarters. They meet in a central situation, and on a given day, weekly. Attached to each office are medical men, midwives, sisters of charity, schoolmasters and mistresses, and, what may appear ludicrous in the eyes of English readers, *lawyers, to give gratuitous advice.* The poor are divided into classes, according to their several wants, and are relieved as much as possible in kind, and labour provided for those out of employment. The funds are derived from *quetes* and collections in and out of churches, and from general revenues of the state distributed through the hands of the Council General of Hospitals."

The government of France, instead of repressing, seems to have encouraged mendicity, and this is the only remedy as yet adopted for the relief of the country population.

*In Italy* charitable institutions are united with municipal regulations for the relief of indigence, and *modified praedial servitude* also prevails, although it has undergone a considerable change by the *agrarian division of land* into small allotments. The owner receives a stipulated proportion of the produce of the land from the cultivator; and should the season be adverse, he supplies the cultivator and his family with food. But it frequently happens that the debt is never repaid, and the owner is thus forced to relieve the indigent. In Lucca, during times of scarcity, the peasants receive advances from the state, although, of late, government has been compelled to take the poor under their own superintendence. In Florence, the government in 1817 established a manufacture for the relief and employment of the poor, embracing, at same time, the plan of domiciliary relief and collections from house to house, and in the churches,—a practice which prevails not only in Italy, but also in Poland, and in many other parts of the continent of Europe. In Lower Saxony a law was lately enacted called the "*Urbarium*," by which the peasant is obliged to perform 104 days labour for about 40 acres of land, half of which must be arable, and is considered as sufficient for the maintenance of himself and family. Besides this labour, Dr Bright, in his Travels, states that they have other feudal services to perform, which generally make the days of labour amount to full 200. But, in times of scarcity, they are often reduced to great distress.

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*In Russia* there are various degrees of praedial servitude, or what amounts to an imperfect emancipation from it; and the charitable relief is rather of a municipal than a religious kind. Heber, in his Notes on Clarke's Travels, states that Catharine greatly ameliorated the condition of the lower orders, or boors, by fixing a specified rent, which very much encouraged their industry. Of the peasants belonging to the nobles, each male is bound to give three days labour weekly for the owner of the land. But if a slave obtains more by trade than in agriculture, he pays a higher rent in proportion, so that his *abrock*, or rent, becomes a tax on his industry. In Russia the aged and infirm are lodged, clothed, and fed at their owner's expense; and as they receive but a scanty subsistence, many of them prefer casual charity, and are furnished with passports to beg. In Poland the peasants are likewise all *serfs* or slaves, and the value of the property depends not so much on the quality and extent of the soil, as on the numbers of peasants it maintains, who are always sold and transferred with the property. The plan of domiciliary contributions has likewise been adopted, and even the ladies of the first rank frequently collect alms from house to house for the relief of the indigent in times of scarcity. Several of the *serfs* and *boors* in Austria and Russia have been emancipated, and their condition ameliorated.

In Mr Voght's excellent Account of the Management of the Poor in Hamburgh, printed in Edinburgh 1795, but not published, he exhibits a plan by which that city supported 7000 poor, by furnishing materials for their workmanship, besides 2500 more in the different hospitals. He states, that the committee of management, to their astonishment, discovered, in the course of their investigation about the earnings of 3500 families, that 2s. a-week was *above the sum* with which a considerable part of the poor could make a shift to live; and that, to give a spur to industry, their principle was to reduce this support lower than what an industrious man or woman, in such circumstances, could earn. The question asked at all such poor as wished for relief, and were able to work, was, whether they did earn by their labour 1s. 6d. a-week, because, by experience, they knew that many poor lived upon that sum; and we know enough (says he) to suppose that 1s. 6d. avowed earning was equal to something more. If they could earn that sum they needed no assistance, and if they could not, then the managers gave them work; and a school was opened to teach them to spin, which was a task easily accomplished in three months, during which time the pauper got at first 2s. a-week, and every week afterwards 2d. less, till in the twelfth week he got nothing at all but his earnings, and was dismissed with a wheel and a pound of flax gratis. The pauper being thus dismissed in a limited time, obviates the objection of providing work for the *unemployed but able-bodied*, since to this extent no injury can be sustained by the community. The expense of this excellent establishment at first was considerable; but in the year 1793-94 the revenue exceeded the expenditure L.2144. There is every reason to believe that, in the great bulk of the country parishes in Scotland, the average expense of the poor does not exceed the sum of 1s. 6d. per week, as above stated, and upon this small pittance many of them contrive to live in considerable comfort. Persons imprisoned for vagrancy in Scotland, by the act 1579, were allowed only to the extent of a pound of oat-meal per day out of the parish funds.

The writer of this article requested an industrious labourer, who had brought up and educated five children, and on whose veracity he could rely, to furnish him with a state of the weekly expenditure of his family throughout the year, and he received from him the following statement.

| | | | |
|---|---|---|---|
| For a family, consisting of six or seven persons, and the children all under 12 years of age, 2½ pecks, that is, 20 Dutch lbs. of oatmeal per week, which will cost at present | L.0 | 3 | 1½ |
| 1 peck, or 8 lbs. of pease or bread meal . | 0 | 0 | 9 |
| For milk and butter 1s. 6d. soap and salt 6d. fire 7d. house-rent 1s. . . . | 0 | 3 | 7 |
| For barley 8d. and for potatoes 6d. . . | 0 | 1 | 2 |
| Weekly maintenance of a family of 7, . | L.0 | 8 | 7½ |

At the average wages of 12s. this will leave 3s. 4½d. weekly for clothing, education, benefit societies, and other expenses. If out of this an industrious man could save 1s. a-week for a few years, how seldom would he or his family require relief, especially if any of his children can be profitably employed? The law, indeed, has found that parents and children, ascendants and descendants, are mutually bound to assist and support one another. From the Assembly's report, it appears that, in the cities of Edinburgh and Glasgow, the expence of each of the regular poor may be stated at somewhere about L.8, per annum; but in the southern districts of Scotland it is only about L.5, in the central L.3, and in the northern L.1; so that the average expence of each pauper in Scotland is little more than L.3 per annum. The number of regular poor is estimated to be about 30,000 in whole, being little more than 1 in the 100 of the population; but those receiving occasional aid from the poors funds are nearly double that number. About five tenths of the sums applied for their relief are made up of grants and voluntary donations, about two-tenths from collections at the church doors, and three-tenths by local assessments. In Scotland, however, the poor in general may be considered as contributing somewhat by their industry towards their own support.

In *Spain*, and other parts of the south of Europe, where little food is required and less clothing, where the climate is mild, and scarcely any shed is necessary for lodging, numbers live the life of a savage, and are constantly idle. Thousands crowd together at the gates of the monasteries in Spain and Portugal for some soup which they receive in charity; and in Naples there are about forty thousand lazzaroni.

*In Ireland,* the provision made for the poor is entirely voluntary, as we learn from Mr Gisborne's Duties of Men. "In Ireland," says his correspondent, "we have no poor laws. Every Sunday a collection is made from the whole congregation, as with you from communicants; and the money is given to a list of poor, agreed on by the minister and churchwardens;—*these poor are parishioners of the establishment.* The number of our rich absentees must greatly lessen public and private contributions for the poor. *In particular cases,* our clergy recommend, and the rich give in proportion to the distress, without regard to the religious denominations."

Mr Duncan, in his Inquiries into the State of the Poor in Ireland, says, "that the helpless, infirm, and destitute seek subsistence from casual charity."—"Wretches who cannot walk abroad to beg are carried from door to door, and set down to obstruct the entrance until they obtain a pittance of meal or money. In Ireland, the tenant or cultivator of the land seldom holds of the proprietor, and between them stands a series of sub-landlords and tenants, and the last in this series must provide for the profit of all." Here is no yeomanry, no agricultural capitalist, and the words peasantry and poor are synonymous. All that the tenant derives from his land and his labour is only his daily potato, and competitors offer the whole value of the produce minus this daily potato. Nothing can exceed the miseries of the poor in Ireland, where there are no municipal charitable establishments of any extent,—no compulsory local assessments,—and where there is neither praedial servitude, nor licensed mendicity, nor voluntary association—where men are born in numbers, as Mr Malthus observes, "to perish by the diseases occasioned by squalid poverty,—by damp and wretched cabins,—by bad and insufficient clothing,—and by the filth of their persons, and occasional want."

Such have been the various modes adopted for the relief of the indigent throughout all the kingdoms of civilized Europe, in the various ages and states of civil society. To these we may likewise add the partial and occasional aid arising from companies and corporations, from guilds and fraternities of artizans and tradesmen, from masonic and benefit societies, and from clubs under various denominations. The farther prosecution of this enquiry is deemed superfluous, as it would only present similar features and modifications of the principles already exhibited.

3. *Of the nature of the English and Scotch Poor-laws, and whether they be founded on the principles of natural right?*—Although this be a question of considerable importance, it still remains undecided. Writers on jurisprudence and morality have found two separate and seemingly opposite interests in society,—the *right of property,* and *the right of self-preservation.* Grotius, in his work *De Jure Belli et Pacis,* lib. ii. endeavours to reconcile these by the law of necessity, which, he says, "was forseen in the first division of property; and therefore a right of revoking this division was tacitly reserved, and a power of again throwing all things into common, if the claims of self-preservation should ever have a stronger right to be attended to than the claims of property." Puffendorf, and along with him Paley, takes a different view of the matter. "To assist the indigent," says he, "in ordinary cases, is a duty of *imperfect obligation;* but in case of extreme necessity, it becomes a duty of *perfect obligation.* Gisborne, again, considers the case of indigence as nothing more than a ground of reasonable expectation of relief; and Malthus concludes that "the poor have *no right to relief.*" Seneca appears to have formed a more correct idea upon this subject than any of these modern moralists, however respectable; and he thus expresses himself in his work *De Beneficiis,* lib. ii. c. 16: "Dabo egenti sed non ut ipse egeam; succurram perituro sed ut ipse non peream." This view appears to coincide with the great law of our nature, which never fails to prompt us to the relief of human misery. The design of this truly benevolent principle was to

afford to the miserable an effectual remedy against the unequal distribution of property. This right is also sufficiently acknowledged and sanctioned by Christianity, as above noticed; and conformable to this was the order given by the apostle Paul for weekly collections for the poor throughout the churches of Galatia. But neither of these two rights of *property* and of *self-preservation* can be maintained without a sovereign power to protect them; and as this power is lodged *in the state*, it is bound as much to protect *the lives* as *the property* of all its subjects. We may therefore conclude, that the indigent have an unquestionable right to relief from the state, or, *through the state*, from those who are possessed of property. On this right, and on this alone, is founded *the principle of the English poor laws.* It may be questioned, however, if this principle can, strictly speaking, be justified in invading the right of property farther than is required by the great law of *self-preservation.* The law itself provides nothing more than the necessaries of life. Conformable to this principle is the enactment of the 43d Eliz. c. 2, "which directs that a tax be raised to provide competent sums for and toward the necessary relief of the lame, impotent, old, blind, and such other among them being poor, and not able to work." On the dissolution of the monasteries, the poor, who had been daily partaking of the alms bestowed at the gates of these religious houses, were naturally averse to labour, and unaccustomed to work; and numerous statutes were passed in the reign of Henry VIII. Edward VI. and Elizabeth, to prevent this inconvenience to which the community were subjected by their idleness and profligacy. The great object, therefore, which the statute of Elizabeth seems to have had in view was, to afford relief to the *diseased and impotent*; to compel the idle and able to labour; and to find work for the industrious and able, by providing materials for this purpose. That the law itself has been subject to great abuse, and by this means has laid upon the people an enormous and almost intolerable burden, cannot be disputed; but the abuse of the administration of a law does not by any means affect the soundness of the principle upon which it is founded. Remove this abuse, and the law itself becomes unexceptionable. In the execution of this law much depends on the appointment of proper persons to the office of overseer. Many of them, from their previous habits or education, are wholly incompetent for such a duty; and the magistrates, by whom these abuses are to be corrected, are often, from their station and habits of expense, induced to form extravagant ideas of what may be requisite for the support of a labourer and his family. What must be the consequence of making the poor completely independent? By this means, would you not eradicate the virtue of charity on the one hand, and, on the other, hold out an irresistible inducement to idleness? The consequence of placing the poor in a state of independence, would be to sap the foundation of voluntary charity, to deprive the labouring poor of their chief and greatest comfort, that of providing for themselves and children, to relax mutual affection between parent and child, and to reward rather than punish idleness and profligacy. To dispose of charity requires much discrimination.—The act of Elizabeth, above quoted, entrusted the disposal of the charitable fund to the churchwardens and a certain number of substantial householders; thus leaving the money under the superintendence of those who contributed it. This act directs, that "the churchwardens and overseers of the poor shall take order, from time to time, for setting to work the children of all such whose parents shall not, by the said churchwardens and overseers, or the greater part of them, be thought able to keep and maintain their children; and also for setting to work all such persons, married or unmarried, having no means to maintain them, and use (using) no ordinary and daily trade to get their living by." And also "to raise, by taxation, &c., a convenient stock of flax, hemp, thread, wool, iron, and other necessary ware and stuff to set the poor to work."—Clause I.

This has been precisely the ground-work of the management of the poor in the city of Hamburgh, to which we have already alluded. By the judicious arrangements, and, indeed, by the gratuitous aid of the principal citizens, this establishment not only defrayed all expenses, but left a very considerable emolument. The principle upon which they acted was precisely that which is contained in this law. "They offered relief to all sorts of poor; and the only condition they required was, that the poor should use towards their own support all the exertions of which they still were capable; and the overseers were directed to pay them weekly what their earnings fell short of 1s. 6d. in every week, when it appeared from their books that they had earned to the known extent of their abilities. This was the infallible standard of real want; and from that moment applications became less frequent,—for whenever the pauper, if in health, (if not he was peculiarly provided for,) had not earned what he could, then he had either been lazy or had found more lucrative work; and, in either case, he was not entitled to relief for that week, whatever he might be for the following. "I have been peculiarly minute here," says Mr Voght, "as I am convinced that it is to this measure alone we owe our success." The authority in the above act, by which the churchwardens and overseers are empowered to provide work for the poor, will require to be exercised with a very delicate hand; lest by carrying it to great extent it should be productive of injury to society. It seems obvious, that the community, strictly speaking, can never be called upon to provide for its individual members farther than is expedient for the *community as a whole*; the preservation of the community in general being the primary object of society. Some writers have been of opinion, that the question as to supporting the poor should be, not so much, has the poor man *a right to relief*, but is it best for the community that he should be relieved? And, on this ground, they object to the *principle* of the English poor laws, in so far as they compel the community to *provide work for the unemployed but able-bodied*,—this operating as a check to that class of tradesmen in whose line the poor are employed, at the expence of the public, and as an encouragement to the increase of a population of paupers, beyond the means of supply of the country, and thereby most materially injuring the community. This remark appears perfectly just, were it not that it supposes an extreme case that never has been, and probably never will occur; and should there ever be any tendency towards this state of matters, the difficulty might be easily obviated by the discretion of the overseers or administrators of the law, in reducing the supply of work. The enormous expense of the poor in England has been occasioned, not by the poor laws, but chiefly by the mode of administration; not by the right which a poor family has of living at the expense of the parish, but by the want of a proper system in the distribution of different kinds of support, by the annual rotation of overseers, by the want of a uniform general plan for making them concur in promoting morality and in encouraging industry. It seems to be in this quarter that some alteration is required in the management of the immense supplies allowed by that generous people to the wants of her poor. In 1680 the poor-rates in England amounted only to L.665,390, and in 1764 they stood at L.1,200,000; but in 1813, 1814, 1815, upon an average, they appear to have produced the enormous and almost insupportable burden of L.10,000,000. In England, it appears, that out of a population of upwards of ten millions, nine and one-fourth are relieved out of each hundred of the population; and in France the proportion is still greater. In several parishes in Berkshire, Mr Page states, that, by an enquiry in November 1821, a fourteenth of the population received relief.

For many years the burden of supporting the poor has been a subject of grievous complaint, and seems to have baffled the skill of the ablest political economists to reduce it. Parliament has likewise given it their utmost attention; and most, if not all, the partial amendments proposed have been rejected as unavailing. If we consider the law itself, we must be satisfied, that the evil rests *not in the law*, but solely *in its administration*. The great object which the statute of Elizabeth had in view was to relieve the impotent poor, and *them only*; to find employment for such as are able to work; and to compel the idle and able to labour, and this principally by providing stocks of raw materials, to be wrought up at their several towns, instead of accumulating all the poor in a common work-house. This statute gave power to the churchwardens and overseers of the poor of every parish, or the greater part of them, with the consent of two justices, one of whom is of the quorum, dwelling in or near the parish, to raise weekly, or otherwise, by taxation of every inhabitant, parson, vicar, and other, and of every occupier of lands, houses, &c. materials for employing the poor, and competent sums for their relief. Notice shall be given in church of every such rate the next Sunday after it is allowed, which may be inspected by every inhabitant paying one shilling, and copies of it granted on demand, sixpence being paid for every twenty-four names; and a churchwarden or overseer refusing shall forfeit twenty shillings to the party aggrieved. The rate is to be levied by distress on those who refuse to pay it; and, by 17 Geo. II. cap. 2. sect. 38., appeals against it are allowed. If the justices find the inhabitants of any parish are not able to levy among themselves sufficient sums for the purposes specified in the act, they may assess any other parish within the hundred, and if the hundred be unable to grant necessary relief, they may rate and assess any parish within the county. 43 Eliz. cap. 2.

For the maintenance of the poor many other acts were subsequently passed under different kings. In order to compel husbands and parents to maintain their own families, the law hath provided, that all persons running away from their parishes, and leaving their families upon the parish, shall be deemed and suffer as incorrigible rogues. 7 Jac. c. 4. And if a person merely threatens to run away and leave his wife and children upon the parish, he shall, upon conviction before one justice, by confession, or oath of one witness, be committed to the house of correction for any time not exceeding one month. 17 Geo. II. c. 5. If persons who have some estates run away and leave their children chargeable to the parish, it shall be lawful for the churchwardens or overseers, by warrant or order of two justices, to take and seize so much of the goods and chattels, and receive so much of the annual-rents and profits of the lands and tenements of such husband, father, or mother as may be necessary for the bringing up and providing for such wife, child, or children. 5 Geo. III. c. 8.

All the evils resulting from the poor laws originated in the system of settlements and removals under the statutes of Charles II., which have now been remedied by the 35th of his late Majesty Geo. III. The law of settlements of the poor may be reduced to the following heads. 1. By birth, for wherever a child is first known to be, that is always *prima facie* the place of settlement till some other can be shown; 2. Legitimate children are settled as their parents, till old enough to gain a settlement of their own, the earliest period of which is seven years; 3. Apprenticeship gains a settlement in a place where the apprentice has resided as such for 40 days, but he must have been legally bound for seven years; 4. Marriage,—the wife follows the husband's settlement, and if he have none, or if it be not known at his death, her own settlement is restored; 5. Other methods of gaining a settlement are all reducible to 40 days residence therein in a public manner by notice; but other ways of acquiring residence are equivalent; such as, 6. Renting for a year a tenement of the yearly value of L. 10, if resided in 40 days; 7. Being liable to the public taxes and levies of the parish, excepting these for scavengers, highways, house, and windows; 8. Residing and executing any annual or public office for a year; unmarried persons without children, hired and serving for a year; 9. Estate,—having an estate of one's own, and residing thereon 40 days, but no settlement is gained by an estate whose purchase was less than L.30. Foreigners, and those whose settlement cannot be known, such as deserted infants, must be kept by the parish where they happen to be. Persons not duly settled may be turned to their own parishes on complaint of the overseers by two justices of the peace, if likely to become chargeable to the parish into which they have intruded, and all persons unlawfully returning shall be judged idle and disorderly persons, and may be committed. Persons legally returned shall be received by the churchwardens or overseers of the poor of the parish to which they shall be removed; and if they receive them not, such persons so offending shall forfeit for each offence L.5 for the use of the poor.

Such is the substance of the English poor laws, which, if correctly and justly administered, could not fail to produce the most beneficial results. It does not appear in any of the English statutes, that the law ever contemplated the pecuniary relief of the *able-bodied* labourer, but merely the relief of those who either had not work or were unable to work; and in this case they are placed precisely in the state of the poor at Hamburgh, for whom work was provided by the purchase of the raw material. They established a flax yarn spinning manufacture, and, out of the profits arising from this establishment, the managers paid all the expenses of house-rent, clothing, and bedding, education of children, expense attending the police of the poor, extraordinary fuel, medical establishment, boarding to the hospitals and bridewell, printing, binding, salaries, and other expenses; and after relieving 7391 individuals in the greatest possible want, a great part of whom had not seen a bed for many years,—after the rags of this great multitude had been all changed to decent dress, and the children all educated,—their revenue in a short time, as already noticed, exceeded their expenditure L.2144 per annum: And might not the poor rates of England, if managed with the same care and dexterity, be productive of the same happy results? The present magnitude of the poor rates in England naturally suggest a doubt whether the relief bestowed upon the able-bodied labourer may not have become in many instances a strong and irresistible motive to idleness, instead of being the support of the aged, diseased, and impotent; yet, was it not for finding work to the industrious and able, for compelling the idle to labour, and for relieving the diseased and impotent, that these laws were originally designed? In later times, however, this relief has lately been extended to the able-bodied labourer, and the quantity of that relief has been measured by the high price of provisions, which is one great cause of the enormous increase of English poor rates. The consequence of this has been, that the English poor laws have produced effects totally different from what they were originally intended. In this great error it may indeed be difficult for the churchwardens and overseers to retrace their steps. But to shew that this is practicable, we may refer the reader to that excellent Treatise on the Principle of the English Poor Laws, by Frederick Page, Esq. one of his majesty's deputy-lieutenants of the county of Berks. To this publication have we been indebted for several suggestions already brought forward in this article; and from what we shall again extract out of that valuable little work, we shall endeavour to shew how and by what means these abuses in the execution of the poor laws may be greatly remedied for the benefit of all concerned. This author states, that the administration of the English poor laws has by the statutes of Geo. III. been placed more effectually in the hands of those who are the most frequent complainants on this subject, namely, the principal proprietors and occupiers of landed property. By these statutes the inhabitants in vestry assembled are empowered to vote according to the gradations of property, and to appoint a select vestry for the care and management of the concerns of the poor in every parish. These powers are contained in the first and second clauses of this statute.

"Every such select vestry is hereby empowered and required to examine into the state and condition of the poor of the parish; and to enquire into and determine upon the *proper objects* of relief, and the *nature and amount* of the relief to be given, and in each case shall take into consideration the *character and conduct* of the poor persons to be relieved, and shall be at liberty to distinguish in the relief to be granted between the deserving and the idle, extravagant or profligate poor." And in the 5th clause it is enacted, "that every order to be made for the relief of any poor person by the churchwardens and overseers of the poor of any parish *not* having a select vestry, under the authority of this act, shall be made by two or more justices, who shall in making every such order, take into their consideration the character and conduct of the person applying for relief, provided that in every such order the *special cause* of granting the relief thereby directed shall be expressly stated,"

So many profit by the abuses of the present administration of the poor laws, that the most active exertions will be requisite in any reformation that may be contemplated; and Mr Page recommends the appointment of an assistant overseer as necessary for the permanence of the distributive administration, and in large parishes to employ another person with the title of vestry-clerk for keeping the accounts. By putting the select vestry act in execution in a prudent and judicious manner, there will be a uniform system of relief and management, and a knowledge of individual character; and few or no appeals will be necessary to the civil magistrate, and no litigation about removals and settlements.

By the judicious administration of the select vestry act and the poor laws, in the parish of Speen in the county of Berks, by the last census in 1821, containing a population of 2392, the average expenditure of the last three years was one-fourth less than the average of the four years preceding, with one-third increased population. This is a striking proof of the benefit resulting from proper administration.

*Provision for the Poor in Scotland.*—The mode of relief which is still *generally* prevalent throughout Scotland, is by weekly contributions at the church on Sabbath, which are put under the superintendence of the kirk-sessions or deacons appointed and ordained for this purpose. This was indeed the original practice of the Christian church, and was the method adopted by the apostle Paul for the relief of the poor saints in the church of Corinth. The providing for the poor was at first under the Christian dispensation regarded as a moral duty rather than a civil obligation, and acts of charity were considered and recommended as amongst the most effectual means of conciliating the divine favour. The apostle does not fix the precise sum to be given by

Modes of relieving.

each individual, but that it shall be such as any man can reasonably spare according to his circumstances. "Now," says the apostle, "concerning the collection for the saints, as I have given order for the churches of Galatia, even so do ye. Upon the first day of the week let every one of you lay by him in store, as God hath prospered him." These contributions were given to the apostles, who entrusted them to deacons appointed for the distribution of this charity, and hence the charge of the poor in the Christian church, and more especially in Scotland, has devolved chiefly upon ecclesiastics. The Edinburgh Review furnishes us with so excellent an account of the mode adopted in Scotland, both in the collection and administration of voluntary alms, that we shall here extract it.

"In those Scottish parishes, the whole public relief which the poor obtain passes to them through the organ of the kirk-session, or ecclesiastical court, composed of elders, who, in general, are men of respectable character, though not always taken from the higher or even midling classes of society. The minister presides over this body with the title of moderator, and he and all such members of his court as have a practical share in the management and distribution of the charitable fund, do almost universally reside within the parish.

"The fund itself is mainly derived from weekly collections, made every Sunday, of the voluntary offerings of those who attend divine service. In addition to this source of revenue, the kirk-sessions have sometimes a small capital, either in money or land, bequeathed to them by charitable individuals, or gradually formed out of the accumulated savings of past years. But we are safe, in saying generally, that the chief part of a session's income arises from the free-will contributions at church, of the inhabitants themselves, aided by certain fees which are exacted at burials and proclamations for marriages, and sometimes by fines for such irregularities of conduct as are subject to ecclesiastical censure and discipline. From the amount of all these items, there must be deducted the expense of certain salaries to clerks and other office-bearers, in order to obtain the free income of each session for charitable purposes.

"But there do occur cases of emergency, such as a year of scarcity or some uncommon depression of manufacturing wages, which, even in our most remote and agricultural districts, has a sensible influence on the price of country labour, and more particularly on the means and comforts of female householders. To provide for such cases, there is sometimes an encroachment made by the kirk-session on its capital, if it has any; or a special collection is made at the church door; or an extraordinary subscription set on foot within the parish; or, lastly, a parish meeting of heritors or land proprietors, who, in general, agree to raise a specified sum, and part in the understanding that each of them will contribute proportionally to his interest in the parish."—*Edin. Review,* Vol. xxviii. p. 9.

Perhaps there is no question of general interest with which the people of Scotland are so little acquainted as that of the poor laws; and this ignorance may be traced back to the period of the reformation. At that time an improved system of morality, with corresponding habits of economy and industry, were happily introduced amongst the lower classes of the community. From this circumstance arises a spirit of independence; and an idea of disgrace, still prevalent among the people of this country, has been attached to all reliance on public charity. Hence, the rights of the poor have seldom been claimed, and the laws, on which these rights are founded, have in a great measure been lost sight of, although it appears that, at a very early period, the proper maintenance of the poor became a national concern. Soon after the reformation, the statute 1597, the basis of the poor laws in Scotland, was passed amidst the violent struggle of the laity on the one hand to maintain their acquisitions, and of the clergy on the other resolutely reclaiming the ancient patrimony of the church as sacred to the support of the poor, of schools, and other charities. As might be expected in an untried path of political economy, the laws relative to the poor in Scotland were at first but very imperfect,—but many of the original defects in the system have since that time been remedied by subsequent improvements. The leading principle of these laws was to avoid any permanent tax, as this would infallibly be an encouragement to idleness and improvidence. The law therefore directs to levy only such a sum as may be necessary for the exigency of the moment, to take inquisition of all aged and impotent poor and decayed persons, and to make enquiry into their several claims, and make out a list of such as require parochial aid, either in whole or in part, and to provide for such, that they may be enabled *to live unbeggan'd.* The adjustment of this list, the quota to be allowed to each, and the fixing the assessment, the law has entrusted to two very respectable bodies of men, who, of all others, are the best qualified to discharge so important and sacred a trust,—to the heritors and landholders, and to the kirk-session, whose official situation makes them particularly acquainted with the circumstances and characters of the most needy and afflicted parishioners. Such is the law according to the statute 1672, cap. 18.; and that is farther rectified and explained by proclamation of the privy-council 1692. Should this duty be at any time neglected by these two bodies, the sheriffs of shires and their deputies, justices of the peace, and magistrates of royal burghs, within their several jurisdictions, are then required to amerciate and fine them therefor in manner specified and prescribed by the proclamation of the 31st July 1694.

Thus the heritors, ministers, and kirk-sessions are, by the law of the land, bound to provide for the poor in their respective parishes, and have the exclusive power of adjusting the roll and modifying the allowance. But should they either refuse to admit on the roll one that is truly necessitous, or allow him what is utterly inadequate for his support, it is competent to crave redress from the courts of law. First, they are to enquire if the claimant be a proper object of charity; and, secondly, what is sufficient to maintain him: and when these two points are ascertained, it is not discretionary, but it is necessary

Mode of assessment.

to enrol him, and to allow him sufficient for his support. To provide the necessary supply, the haill inhabitants within the parochin, according to their substance, without exception of persons, are to be taxed by the statute of James VI. Par. 6. cap. 74. and the act 1663 is sufficiently broad to apply to all mills, coal-works, manufactories, and other subjects yielding a revenue to the proprietor or undertaker, after deducting allowance for necessary repairs. Tenants may be taxed according to their means of subsistence, but the rule generally adopted is their real rents. To guard against a numerous list of poor, it has always been the practice, from dearth of provisions, stagnation of trade or manufactures, to assist those persons who, by misfortune or disease, may be disabled for a time from supporting themselves, or who, though willing to work, yet with their utmost exertions are unable to maintain themselves and families, such as widows with numerous children. To this kind of preventive charity is to be ascribed all that private happiness and that public advantage which enables such families to support their respectability, and prevent them from falling into that degraded class of citizens who must live by alms and begging. In cases like the above, the money is sometimes lent instead of being given as charity. It is obvious, that the law makes no provision for any individual possessed of property, either in land, houses, or money, although it appears that a person may be entitled to some allowance, without being obliged to part with indispensable articles of furniture, such as bed, blankets, &c.; and in many instances the administrators of the poor take an inventory of the pauper's furniture, which, before being put upon the poor's roll, he agrees to give up, and which is sold for the amount of his funeral expenses at his decease, and the balance, if any, is paid into the poor's fund. This, however, is merely a precaution to prevent the pauper from giving away every article he is possessed of to worthless persons, who may take advantage of his weakness while in a dying state.

The statute, on the authority of which assessments are imposed in Scotland, is that of 1663, cap. 16. which ordains "Heritors of each parochin, or as many of them as shall happen to meet, upon public intimation made at the paroch kirk upon any Sunday at the dissolving of the church from the first sermon, by any of the heritors of the paroch, or by employers of the poor, to make up a stent-roll for maintenance of the poor in their paroch, who shall be employed as said is at the rate aforesaid, the *one-half thereof* to be paid by the *heritors*, EITHER conform to the *old extent of their lands* within the paroch, *or* conform to the *valuation by which they last paid assessment*, or *otherwise, as the major part of the heritors so meeting shall agree*, liferenters and wadsetters always being liable during their rights as heritors, and the *other half* thereof to be laid upon the *tenants and possessors according to their means and substance*."

It appears to be a great, although a very general error, to consider the act 1663, c. 16. as the authority for levying assessments for the support of the poor. Those who will take the trouble to look at the statute will observe, that it regards solely the vagabonds, &c. who were to be employed in workhouses, and has no reference whatever to the parochial poor. It forms one of a series of enactments of police for the repressing of vagabonds, which have now fallen into total desuetude. The power of levying assessments for the parochial poor depends solely on the act 1579, c. 74. and the proclamations of the privy council, in which opinion both Mr Hutchison, in his treatise on the office of Justice of Peace, and Mr Dunlop, in his treatise on the Law of Scotland relative to the Poor, concur.

This statute 1579, c. 74. ordains "to tax and stent the haill inhabitants within the parochin, according to the estimation of their substance, without exception of persounes." "It is true," says Mr Dunlop, speaking of the act 1663, "that the plan of dividing the assessment into two parts, the one to be levied from the heritors and the other from the householders, was subsequently adopted, instead of the mode directed by the act 1579 of levying it from the whole inhabitants in one class, and that the period of three years, as fixing the settlement of a pauper, instead of seven, has also been borrowed from this act; but, except in these particulars, adopted in subsequent enactments, this statute may be considered as in total desuetude."

The act of the privy council of Scotland, August 11, 1692, ratified by the act 1698, does in effect the very same thing as the act 1663, as it requires *heritors, ministers, and elders*, of every parish, to make lists of the poor within the parish, and to cast up the quota of what may entertain them according to their respective need; and to cast the quota *one-half* on the heritors, and the *other half* upon the householders in the parish. The yearly meetings are declared to be the *First Tuesdays of February and August.*

Assessment, according to the *valued rent*, may, in certain cases, be liable to considerable objections, as it may be very *unequal* in its operation; and an instance of this occurred in the parish of St Cuthbert's, 1766. Under the words *or otherwise*, in this statute 1663, a discretionary power is therefore left to assess by the *real rent*, where that appears more conducive to *equality*. In the assessment laid on in the parish of St Cuthberts 1766, agreeably to the valued rent, it was found that this mode bore very hard upon the *tenantry in the landward part* of the parish, as the rents of the houses were nearly three times greater than the rents of the lands, whereas the valued rent of the lands was nearly ten times more than the valued rent of the ground of the houses which was valued, so that the *rural tenants* would pay nearly 40 times more than the *urban*, although these last furnished almost the whole poor of the parish. This mode, therefore, was altered, and an assessment was laid on from Whitsunday 1769 to Whitsunday 1770, agreeably to the REAL RENT, one-half payable by proprietors of lands, houses, and feus, allowing a deduction for repairs of one-fourth of the rental, and none under 40s. of rent to be assessed as tenant, which arrangement was sanctioned by the Court of Session in a declarator in July 1772, and the case is collected in Wallace's Decisions, No. 47. From that period to the present time this rule has been constantly ob-

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served, and the heritors and kirk-session of St Cuthbert's meet, for this purpose, *annually*, on the first Tuesday of August, fourteen days after edictal citation in the church and public advertisement in the newspapers. At this meeting a committee is appointed, of whom three is a quorum, to give occasional directions to the collector then elected, and to receive his bond of cautionary. After this the collector makes up his annual rental of the parish; and if any heritor or tenant may think himself over-rated, the committee has power to give him redress. The rents are taken very moderately, and the collector begins his collection in the first week of January; and as the parish is extensive and populous, it is for the most part in July that he makes up his accounts, which are audited by the committee, who report to the August meeting, before laying on the new assessment. It may be observed, that the landlord or proprietor obtains the whole deduction of 1-4th for the repairs. Thus, suppose the assessment 6d. in the pound of real rent, the tenant of a house of L.20 rent would pay one-half, which is 5s., but the proprietor, deducting his own fourth for repairs, would pay only 3s. 9d., amounting in whole to 8s. 9d. But if the proprietor himself possess the house as tenant, then he pays only on a rental of L.15, which is 7s. 6d. When cases of a complicated nature occur, the discretionary powers of the heritors and session have always been sustained, when exercised in a fair and equitable manner. We have been thus particular, as the above may be considered as a safe rule of assessment for other parishes in Scotland where they may be found unavoidable.

As very few questions respecting residence occur in Scotland, it may be sufficient merely to mention, that the ordinary place of residence during the three last years, in which the individual has maintained himself without charity, constitutes a legal settlement, and that such residence must precede the pauper's falling into poverty, and not merely his application for charity. A woman also obtains a settlement by marriage, and if she becomes a widow, she retains the settlement of the deceased till she acquire a new settlement either by residence or subsequent marriage. Legitimate children follow the settlement of their father, and illegitimate that of the mother, even although the father be known. Birth gives a settlement although the parent have none in the parish, but if he have a settlement elsewhere, it is primarily liable. Thus, if a father having no settlement die, the child's settlement is that of its birth. Paupers are entitled to support in the parish in which they were born, till such time as a settlement in some other parish be acquired by marriage or residence.

A bill was introduced into Parliament in 1824 to alter the laws relative to the poor in Scotland, which in almost every point of view was found highly objectionable, and which therefore was abandoned. By the first clause of this bill, the pauper was deprived of the power of appealing to the civil magistrate, and left to the determination of the ministers and elders, who were to have the sole administration of the collections and other funds not accruing from assessments. By the second clause, the heritors and ministers were to have the exclusive right of imposing assessments; by the third, it was to be enacted, that after a certain date no assistance should be given to the poor who shall apply for the first time except from the funds under the control of the ministers and elders, a clause which would strike at the root of charitable establishments, and eventually inundate the country with beggars, such funds in several parishes being insufficient to supply a tenth part of the paupers. The fourth clause empowered heritors of parishes where assessments have existed previous to the passing of the act, to continue annually to impose such assessment as shall meet the exigencies of such cases of relief as were granted before the bill passed into a law. No appeal was to be allowed to any pauper, and the judge-ordinary or sheriff could only decide as to what parish a pauper belonged. This bill, therefore, was strongly opposed both by the landed proprietors and clergy, and was found totally inexpedient and uncalled for.

Modes of relieving.

In the law of Scotland, as well as in the administration of the poor's funds, there appears to be a material difference from those of England. Till of late years the law of Scotland, relative to the poor, was never put in execution, and the circumstances which occasioned this neglect may be easily accounted for by historical facts. In England the work of the reformation was conducted by the king in the way he deemed most proper without any opposition from the established clergy, whose possessions he left entire. In Scotland, however, the case was quite different. The reformation there was produced by a religious zeal, and the whole order of the established clergy, whether regular or secular, were, without any consideration of feeling or humanity entirely swept away. Immediately in their place sprung up a new order of clergy, whose popularity rested solely on the sanctity of their lives, real or imaginary. Their great recommendations to the people consisted in religious zeal, and a purer morality of conduct, by which they imitated or professed to imitate the lives of the Apostles; and of course they were zealous in recommending to their hearers the practice of the early Christians, especially in their charity and alms, as one of the most effectual means of rendering them acceptable to God. To preserve the high character they had attained, it was of the greatest consequence that they should effectually guard against every appearance of interested conduct, and they were therefore cautious enough not to interfere with worldly concerns; so that, instead of receiving private donations themselves as almoners for the poor, they appointed a tribunal of elders, men of distinguished regularity and good conduct, to whom should be committed the sole collection and distribution of all monies given in alms and charity, under the control of the minister, and at length of the proprietors or heritors of the parish. In this way alms-giving continued to be considered in Scotland as a meritorious and *religious* act, while in England such practice fell into total disrepute and was entirely neglected; and hence there did not exist in both countries the same imperious call for a compulsory poor law. There were indeed at different times clamours in Scotland by disorderly persons who felt themselves excluded

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from all participation in the poors funds, which occasioned some rash enactments on this subject; but the nation at large was at all times abundantly satisfied that the *real* poor were sufficiently provided for by voluntary contributions, and hence none of these laws ever received their countenance or support, but have been, except in a few cases, suffered to fall into general neglect.

To these circumstances, in some degree, are the inhabitants of Scotland indebted for the very moderate expenses of their poor when compared with those of England, although there is reason to apprehend, that a still greater cause of this difference consists in the care and attention with which the funds are administered. This will be most effectually illustrated by an example. In Sir John Sinclair's statistics there is an account of the poor of Dunnichen in Scotland, the population of which parish, at that time, was 872, being supported, and a great surplus saved out of L.20 a-year, and this is brought as an evidence that the maintenance of the poor may be safely entrusted to voluntary contribubution. Mr Young stated, in his Annals of Agriculture, that, from an extract out of the rate-book and register of the parish of Chelmsford in Suffolk, from 1772 to 1790 inclusive, the rates had increased from L.678 to L.1062. This enormous rise was attributed to nothing else than those glaring abuses in parochial management which are so generally prevalent in parishes where there is no individual to restrain them, although such an evil in ninety-nine cases out of an hundred, even in England, is not without remedy. And how can we feel for such persons as tolerate such abuses, who, instead of lending their aid to a select vestry for the management of the concerns of the poor, allow to parish officers and justices of the peace, and often to parish officers alone, an unlimited power of taxation? Do they not allow and sanction such oppression? and as Mr Young justly observes, "doubtless there are in such parishes little farmers heavily and cruelly burdened either to support sturdy beggars, who can but will not work, and who are richer in fact than themselves, or to contribute to the illicit profits of men who thrive by abuses thus tolerated by the legislature of a country that calls itself free." It is to be considered as the boast and the glory of Scotland, that, for now upwards of 200 years, she has been enabled, by the Sabbath collections at the church doors, under a wise and simple economy, to support her poor in circumstances perhaps as comfortable as those of England, without ever having had recourse, excepting of late years, in a few instances, to any legal assessment. The salutary example of her judicious mode of provision for the poor, practised among a people who were strangers to luxury, if properly considered, will be deemed not unworthy of the imitation of other countries. This system, so long practised in Scotland, is founded on Christian charity alone, and by its natural operation is calculated to diffuse good will and kind affections among all ranks without any legal intricacies or compulsion.

This mode of relief, in another point of view, is productive of incalculable advantage, since, with the poor themselves, it operates as a powerful stimulus to great exertions, and preserves that noble spirit which urges men, by industry and economy, to maintain their independence and respectability. Every man in Scotland, therefore, feels himself degraded, and sunk, not only in the estimation of his neighbours but in his own, should he, upon any ordinary occasion, seek or require parochial relief out of that fund which has been collected as alms for the poor. But it has been found by experience, in those parishes in which a compulsory assessment has taken place, that the feeling is very different, and many of the labouring classes will there demand their share of the money which they conceive belongs of right to the industrious labourer; and hence the tendency of public assessments to promote the increase of pauperism. In England, the first assessments under 43d of Elizabeth did not amount to 2d. in the pound of rent; but in many cases it now amounts to 20s. that is to say, to one-half of the real rent.

There is, after all, perhaps no country in the world in which the poor are more amply provided for than in Scotland, or where they enjoy a greater share of real comfort, or feel their distress more kindly sympathised with. In that country, every one feels it is "more blessed to give than to receive." From their earliest years, it is their ambition to use every honourable means to guard against the possibility of ever requiring support from others; and, so far from being clamorous for relief, it is frequently necessary for the clergyman and elders to enquire privately into the circumstances of such as may be disabled from following their usual occupations, that they may not be suffered to want. For in many cases, there are persons who would rather die than suffer their wants to be made known, and nothing can reconcile them to the idea of receiving favours without a return. This system of relief in Scotland, therefore, may be considered as a system of mutual endearment between the rich and the poor.

But let it not be imagined that the money distributed by the administrators to the poor in Scotland is all that they receive. Besides this, there are many other channels through which they derive consolation and support, all of them productive of the happiest effects. In the vigour of life, a son exerts every nerve to spare a little of his earnings to enable his aged parents to spend their declining years in ease and comfort, and would feel mortified to think that they should require the assistance of public charity to support them. If the children be numerous, they vie with each other which of them shall shew the greatest kindness; and the Sabbath family visit, on which day all the children usually assemble, has the happy effect of endearing them to one another, and of strengthening their mutual love. The children are informed of all the kindness of their friends and neighbours, and strive to repay, by their assiduities and attention, the favours conferred upon their aged parents. The neighbours and benefactors thus participate of the good will and gratitude of the children; so that friendships and connections are thus formed, which are happily calculated to unite the whole community in mutual esteem, and to preserve the social union in its highest purity. It is obvious that the reverse of all this is the effect of compulsory assessments; and what friend to his country would ever wish to see this picture defaced?

4. *What is the most eligible plan for the maintenance and relief of the poor?*—By this time, no doubt, the reader will be prepared to think that mode of relief the best that is most remote from compulsory laws, unless in cases of the most urgent necessity, and, consequently, that which approaches nearest to moral duty and obligation. On all reasonable and proper occasions, daily experience demonstrates to us how liberal and how bountiful are the dispositions of every good and charitable heart. Witness the vast sums at various times collected in Britain for the sufferers in Russia,—for the sufferers in Ireland,—for the sufferers by the late destructive fires in Edinburgh. And how great and noble are the contributions by which the numerous religious charitable institutions of Europe have been so long and so liberally supported! Can it ever, then, be supposed that, among a people influenced by such feelings, the poor in their neighbourhood, and at their own door, could be allowed to starve, or that, upon a candid appeal to the feelings of opulent individuals, or of the public at large, they would be permitted to want whatever may be necessarily required for their comfort or support? That in many parishes there may be individuals who are utterly destitute of sympathy, who love money on its own account, and who are utter strangers to alms-giving and charity, cannot be disputed; yet for the honour of human nature, these are in number comparatively few.

It is, however, a melancholy truth that the condition of the great multitude of poor in *Ireland* is the reverse of the picture we have here drawn of the poor of Scotland. But, does not this, it may be asked, arise solely from their want of education, of moral feeling, and proper habits, which nothing can alter but religious instruction and the progress of civilization. Wherever the principles of Christianity exist, there must likewise prevail a kindly disposition, and a desire to befriend and assist those who, by age or sickness, have been reduced to a destitute condition. With a good man no compulsion is necessary to induce him to relieve the indigent. To perform such a duty constitutes his chief felicity.

That system of provision for the poor appears to be the most eligible by which the funds are raised, *directly* or *indirectly*, by each denomination of Christians for their own poor, and are *locally applied*. In those places where this is the practice, the poor appear to be, on the whole, most comfortable, most contented, and maintained at by much the smallest expense. The funds for their support are collected, according to the great law of religious feeling and moral obligation, from relations, neighbours, friends, benefactors, and other charitable individuals. But in addition to this, it is necessary that the relief of the poor should form an object of the legislature so soon as voluntary charity shall prove inadequate, and when *no other remedy* can be found; and if the law be justly and properly administered, the community at large can never materially suffer. The *first object*, however, in every provision of this kind, and by which every establishment of a charitable nature must stand or fall at last, is to prevent any individual from receiving charitable relief while he is able to earn sufficient to maintain himself, and to take care that he shall use every exertion of which he is capable towards his own support. *The next rule* should be to give nothing more than bare subsistence, or at least to reduce the support lower than any industrious man or woman could easily earn, otherwise relief becomes a premium for profligacy and idleness. *Another important rule should be,* to oblige parents and children mutually to aid one another by the contribution of a slender pittance weekly, whenever they are entered upon the poor's roll. The law has one error to guard against, which is not to do too much. The more that is done for the poor by the community, experience shows that the less will the poor, in general, do for themselves. Few individuals will submit to constant labour if they can afford to be idle. The provision of food for the poor, of clothing and shelter, should be comfortable, but not superfluous. Every parish should likewise provide materials for work of some kind or other for the idle, but such kind of work as shall be far less productive than ordinary labour, and in which children could be employed some hours daily, and be paid for their work after they are seven years of age. These very simple rules, with a few others respecting the law of settlement and residence, would be a sufficient remedy for many complicated evils.

The benefit of schools, and of medical institutions where advice is given gratuitously to those not yet entitled to charity, may be highly useful in preventing many a family from ever becoming burdensome to the community, and might counteract many of those evils which impose on a man the disreputable necessity of throwing himself upon the public charity. In some parishes it is a rule, that the surgeon be paid for his drugs, but not for his attendance. All benefit societies, under whatever name, if properly conducted, are eminently useful, as they encourage sobriety and economy. And it might even be useful if the landed proprietors, under certain restrictions, were to receive the sums of such societies, and, if small, to pay *compound interest*, as this might afterwards relieve them from more burdensome contributions. Extensive charitable or friendly institutions, by a small yearly sacrifice of this kind, might save many a family from becoming burdensome either to the institution or the community. A trifling assistance in the payment of house-rent, in compounding for the payment of small debts, or releasing pawned goods, and, lastly, the multiplication of employments, especially for female children, such as all kinds of needle-work, making clothes, shoes, hair-dressing, straw-plaiting, knitting stockings, and all easy work of such nature, might likewise be highly useful, and, above all, moral education. Without this, every other effort to promote the comfort and independence of the rising generation must infallibly fail. Towards this, the institution of male and female seminaries, nursing-rooms, and magdalen-houses, well regulated, might be very beneficial. How many of the errors, vices, and miseries among the lower orders arise from ignorance and want of advice. See *Prison Discipline*, under the article ECONOMY POLITICAL.

Among the various means adopted for ameliorating the condition of the poor, *licenced mendicity* appears to be extremely exceptionable. It furnishes the strongest inducement to falsehood, in order to excite compassion, and especially the compassion of servants who have the charge of property belonging to their master,—thus holding out to them a powerful temptation to dishonesty; and when falsehood cannot prevail, acts of theft naturally follow. Begging is the offspring of idleness and profligacy; but till adequate funds of some kind or other be provided for the poor, to which they can have access, the punishment of mendicity must be considered as an act of cruelty.

Another objectionable remedy for the relief of indigence, is that of *a public receptacle*; but if this be permitted, two paupers only should be allowed to occupy one apartment, and the allowances should be the same as for those resident out of it. The poor, in general, can best provide lodgings for themselves among their friends; and the sacrifices which the poor often make to relieve one another, can be known only to those who enter into their concerns; but no sooner is an indigent individual enrolled in the list of paupers, than all those kindly feelings of his relations and neighbours towards him entirely cease.

Another mode of relieving indigence equally exceptionable, is that of *foundling hospitals*, which are said to contain a large proportion of legitimate children. In Paris, the proportion of legitimate children received is stated at one out of eight, and that of Russia still more. Mr Malthus states that, in the latter country, nearly all those that find any difficulty in rearing their children, send them to the foundling hospital, where the mortality is prodigious, and where it had not been uncommon, during the winter of 1787, to bury 18 a day. All writers on this subject testify their abhorrence of this mode of relief. "With regard to the moral feelings of a nation," says Mr Malthus, "it is difficult to conceive that they must not be very sensibly impaired, by encouraging mothers to desert their offspring, and endeavouring to teach them that their love for their new-born infants is a prejudice which it is the interest of their country to eradicate." "I consider an hospital," says Mr Wakefield, "that presents an open basket to receive every infant without distinction, as one of the greatest evils that can be devised by human ingenuity. Even if well regulated in its internal regulations, it holds out encouragement to all kinds of vice, and imperceptibly deadens the finest feelings of the human heart. The poor are tempted to part with their offspring, to resign into the hands of strangers the most endearing of all parental employments, that of a mother fostering her own child. But if it should chance to be badly conducted humanity must be farther shocked, while the miserable victims are left to bewail the conduct of unnatural parents, and the existence of so vile an institution." In the course of 13 years previous to 1798, no less than 27,274 children were received into the founding hospital in Dublin, out of which 13,120, or nearly one-half, perished; but in the last of these years, out of 1922 admitted, no less than 1457 died; and by the report of the commissioners, in the course of one year, 1237 children died out of 1458. This institution is supported by a revenue of upwards of L.8,000 a-year, arising from a tax on houses within the several parishes of Dublin, and within two miles of the castle. The children of this hospital are all educated in the Protestant faith, and many of the children of Catholics are among them. Dupin calculated, that out of twenty-five children received into the hospital, three or four will be living at the end of twelve years, whereas thirteen or fourteen will be alive of those nursed at home. In the foundling hospital at Lyons, Vernignac states that only 28 children were alive on the first of February 1796 out of 820 received from May 1795.

*In England* the mode adopted for the provision of illegitimate children is materially different. In the eye of the law both parents are equally criminal, and both are equally compelled to contribute to their support, although ultimately the father is in general burdened with the expense, and the care of the child is usually entrusted to the mother, so that its chance of preservation is equal to that of any other child.

We concur in opinion with Mr Page, to whom we are indebted for many of the above remarks, that "Scotland and England are approaching to similar practice, but beginning at different points. In Scotland the administration is perfect; the local assessment is just commencing. In England the equal local assessment is perhaps as complete as the varied nature of property will admit; the ameliorated administration is yet in its infancy." We ask then, what has England to do to render her system of poor laws perfect, but to copy the ameliorated administration from the Scotch; and what have the Scotch to do, in order to preserve the perfection of their system, but to guard against the evils which a local assessment has produced in England? Upon this, indeed, every thing depends, and without this the evil of assessment so much complained of in England as intolerable can never be remedied.

The different works consulted in the compilation of this article are, *The Principles of the English Poor Laws Illustrated and Defended,* by Frederick Page, Esq. one of his Majesty's deputy-lieutenants for the county of Berks; *Edinburgh Review, Vol. XXVIII.* Degerando *Visiteur du Pauvre*; Grotius *de Jure Belli et Pacis*; *Essay on the Principle of Population*, by Mr Malthus; Dr Burns' *History of the Poor Laws*; *Treatise on the Poor Laws*, by T. P. Courtenay, Esq. M. P.; *History of the Poor*, by Sir Fred. Eden; *Collections relative to the Systematic Relief of the Poor*, by Mr Duncan; *Consideration of the Poor Laws*, by Mr Davidson; Dupin *Histoire de l'Administration des sécours Publics*; *Bee*, by Dr Anderson; *Account of the Management of the Poor in Hamburgh since the year* 1788, by Caspar Voght, Esq.; *Treatise on the Law of Scotland relative to the Poor*, by Alexander Dunlop, Jun. Esq. advocate; Hutchison's *Justice of the Peace.*

POPAYAN, a province of the viceroyalty of New Grenada, in South America, is about 128 leagues in length, and 100 in width, and is bounded by Alacamo on the south, by Quixos on the east, by Llanos de Neiva on the north, and by Choco and the Pacific on the west. Through this province run the central and the highest branch of the three parallel chains of the Andes. The climate is mild and salubrious, and between summer and winter there is no other distinction than that the rains are less abundant in the months of June, July, and August. Grains and fruits are produced in abundance, and horned cattle and sheep are reared in great numbers. A considerable trade is carried on with Quito, Choco, and other places. The exports consist chiefly of cattle, mules, cloths, raw cotton, dried beef, salted pork, and tobacco,—in return for which are received precious metals, sugar, snuff, and other produce.

Popayan, the capital of the province of the same name, stands on a plain, elevated 5905 feet above the sea, in west longitude 76° 39′ 54″, and north lat. 2° 26′ 18″. A river named Del Molina runs through it, and is crossed by a stone and a wooden bridge. Popayan contains many handsome houses, which are constructed of unburnt bricks. It is built in a square form, and the streets are straight, broad, and level. It is a flourishing place, and contains a population estimated by some at 25,000, but by others at only 8000. The Dominicans, Franciscans, and Augustines, have all churches in the city. At the royal mint established here there are annually coined a million of dollars.

POPE, from the Greek, signifying *father*, is an appellation by which bishops were called in the west in ancient times, and which has been for a number of centuries appropriated to the bishop of Rome, he being considered by the Roman catholics as the common father of all Christians. Under this head we shall state a few particulars concerning the office of the Roman pontiff, referring the reader to the article Popery for a historical sketch of the rise, progress, and decline of the papal power, and to Religion for an account of the doctrines and practices of the Romish church.

To enable the reader to form a correct idea of the rights which all in communion with the see of Rome consider as inherent in the pope, it will be proper to observe, that the Roman Catholics maintain, that St Peter, the apostle, was constituted by our Saviour chief pastor under himself, and had conferred on him the requisite power to watch over his whole flock here on earth, and to preserve the unity thereof; that it was ordained that this apostle should have successors to the end of time, who should enjoy a similar charge and authority; and that from the circumstance of St Peter having suffered martyrdom at Rome, where he resided for many years, the bishops of that city are consequently his successors in the dignity and office of universal pastor of the whole Catholic church. As the pope is the first bishop in order and dignity, he is supposed to hold a power and jurisdiction over all Christians, for the preservation of unity and purity of faith and moral doctrine in all churches. Thus, when the pope understands that any error has been broached against faith or manners, or that any considerable difference on such subjects has taken place in any part of Christendom, he has the power to issue out his pastoral decree condemning the error, and declaring what has been delivered down, and what is to be believed. It has been supposed by some divines among the Roman catholics, that when the pope thus addresses himself to all the faithful of the church he cannot err. The infallibility of the pope, however, even when he pronounces in the most solemn manner, is merely suppositional, and not an article of faith. The author of a Classical Tour through Italy, in speaking of this subject, observes, "There is no such article as the infallibility of the pope in the catholic creed, for, according to it, infallibility is ascribed not to any individual, or even to any national church, but to the whole body of the church extended over the universe. That several theologians, particularly Italian and Spanish, have exaggerated the power and the privileges of the pope, is admitted; and it is well known, that among these some, or rather several, carried their opinion of pontifical prerogation so high as to maintain that the pontiff, when deciding *excathedrâ*, or officially, and in capacity of first pastor and teacher of the church, with all the forms and circumstances that ought to accompany legal precisions, such as freedom, deliberation, consultation, &c. was by the special protection of Providence secured from error. The Roman court favoured a doctrine so conformable to its general feelings, and of course encouraged its propagation, but never pretended to attach any marks of censure to the contrary opinion. This latter opinion, the ancient and unadulterated docrine of the Catholic church, prevailed over Germany, the Austrian empire, Poland, the Low Countries, and England; and in France was supported by the authority of the whole Gallican church, and by the unanimous declaration of all the universities. So rigorously indeed was their hostility to papal infallibility enforced, that no theologian was admitted to degrees unless he maintained, in a public act, the four famous resolutions of the Gallican church against the exaggerated doctrines of some Italian divines relative to the powers of the Roman see. These resolutions declare, that the pope, though superior to each bishop individually, is yet inferior to the body of bishops assembled in council; that his decisions are liable to error, and can only command our assent when confirmed by the authority of the church at large; that his power is purely spiritual, and extends neither directly nor indirectly to the temporalities, nor to the prerogatives of kings and princes; and, in fine, that his authority is not absolute or despotic, but confined within the bounds prescribed by the canons and the customs of the church. This doctrine was taught in all the theological schools, that is, in all the universities and seminaries of France, as well as in all the abbeys, and was publicly maintained by the English Benedictine college at Douay. The conclusion to be drawn from these observations is, that no Catholic divine, however attached to papal prerogative, ever conceived an idea so absurd as that of ascribing infallibility to the person of the pontiff; and, secondly, that those theologians who ascribed infallibility to papal decisions, when clothed with certain forms, gave it as their opinion only, but never presumed to enforce it as the doctrine of the Catholic church." Mr Eustace, whom we have now quoted, is doubtless a judicious and liberal author; but on the subject alluded to, his statements, though essentially true, are somewhat tinged by the partiality of Roman prejudice.

The pope may be considered in two very different capacities as temporal sovereign of the Roman territory, and as chief pastor of the Catholic church. He is bishop of Rome, metropolitan and primate of Italy, of Sicily, and of Macedonia, and patriarch of the West; in which several capacities he enjoys the same privileges and authority as are enjoyed by other bishops, metropolitans, primates, and patriarchs, in their particular dioceses and districts; his authority being like theirs confined within certain limits marked out by ancient custom and by the canons, and liable also to be modified or suspended by the church at large. He ranks, as patriarch of the West, before all western ecclesiastics, and takes place and precedency on all public occasions. As successor of St Peter, he sits in the dignified capacity of first pastor by divine institution of the Catholic church. To him, moreover, belongs the primacy of honour and jurisdiction over the whole Christian church; but the precise rights and prerogatives which by this primacy he enjoys, and which are inseparably annexed to it, have not been by any authority determined. The prerogative of the pope as a sovereign is uncontrolled by any legal or constitutional authority; a despotism which, however mildly it may be exercised, is not adapted to promote the interests of the people, or the happiness of the prince himself, who, if alive to sentiments of religion and of moral obligation, cannot but tremble under the weight of responsibility imposed upon him by the elevated station he holds. Did not the pages of history convince us how sweet despotic sway is to the vitiated palate of sovereigns, we might be tempted to wonder that the experiment never has been tried by the Roman pontiff of sharing his power and authority with the best and wisest members of the state, as such a measure would unquestionably prove safe and advantageous.

To the papal office no temporal advantages are originally or by its institution annexed; but such an office could not fail to acquire weight and consideration, and indeed the bishop of Rome appears, even in the very commencement of Christianity, to have attained such influence and authority as to attract the attention of the emperors. It may be easily conceived, that when Christianity was embraced by the emperors, the pope would acquire a great increase of temporal weight and dignity; and, besides the consideration inseparable from the office itself, the extensive possessions of land, and the vast riches in plate of the church, would evidently be to him the source of much temporal greatness. It may be inferred from ancient authors, that these riches were very great even under the pagan emperors, and in the time of the persecutions; and by the liberal donations of the Christian princes, especially of Constantine the Great, they were very much increased. See Popery.

The pope has no temporal power or jurisdiction beyond the limits of his own temporal dominions, excepting what any nation may please to allow him. As chief pastor of the church, he has no right to any temporal jurisdiction over his flock, nor has he any means of coercion originally or necessarily connected with his power as chief pastor, but only ecclesiastical censure. In some ages, however, the popes interfered a great deal in the temporal affairs of the different kingdoms of Europe, which interference, whatever might be the motives to it, proved injurious to the interests of religion. Yet it must be acknowledged, that a Roman catholic is not obliged to approve what they have done: on the contrary, he may, without impropriety, freely judge of them according to their merits, entertaining at same time a due feeling of respect and regret. Thus a Roman catholic may either apologize, if he think he can do it, for the conduct of Innocent III. in deposing King John of England, or, without being guilty of any offence against his religion, he may disapprove of what the pontiff did on that occasion, because the power of the pope to depose princes, or to absolve subjects from their allegiance, was never proposed as an article of faith, or made a term of communion with the church of Rome. Unquestionably there were some catholic divines, especially among the Jesuits, who maintained this delusive opinion, but the greater part of them condemn and abhor it as absurd and impious; and surely it is but just to admit, that they must or ought to know best what themselves believe.

The income and expenditure of the Roman court must not be overlooked in an account of the rights which the Roman catholics consider as inherent in the successor of St Peter. When this court was in full possession of its territory, both in Italy and France, its income was estimated at six hundred thousand pounds; but in consequence of the many alterations which of late years have taken place, it is now very much reduced. The revolutionary invasion of Italy, and the consequent dismemberment of part of the Roman territory, lessened the papal income, not only by diminishing the number of persons who contributed to it, but by impoverishing all the inhabitants of the Roman state. On this subject Mr Eustace makes the following remarks: "Contrary to a very general opinion, I must here observe, that this income arose principally from internal taxation, and that a very small part of it was derived from Catholic countries. The sums remitted by Catholic countries may be comprised under the two heads of annats and dispensations; now, these two heads, when united, did not produce in France, the richest and most extensive of Catholic countries previous to the revolution, more than fifteen thousand pounds per annum. In Spain the annats had been abolished, or rather bought up, and in Germany, if I mistake not, suppressed. Dispensations, that is, licences to take orders to hold livings, to contract marriages, and do various acts in cases and circumstances contrary to the prescriptions of the common canon law, produced merely sufficient to pay the expenses of the courts through which they necessarily passed, and added little to the papal revenue. As for the concourse of pilgrims which was supposed to be so very productive a source of income, it brought nothing to Rome but the filth and the beggary of Catholic Europe. The far greater part of these pilgrims were not only too poor to bring an accession of wealth to the city, but even to support themselves, and were generally fed and lodged in hospitals expressly endowed for their reception. Into these hospitals seven hundred or more have frequently been admitted at a time, and supplied, not only with the necessaries, but even with the comforts of life." Without adverting to those articles which are common to all governments, such as the army, certain officers of state, magistracies, &c. it may be observed, concerning the expenditure of the Roman court, that the propagation of Christianity is the grand cause of disbursement to the pontifical treasury. In the early ages, and even in later times, the chief occupation of the Roman pontiffs was the propagation of Christianity. The provinces of the Roman empire employed their zeal in this undertaking in the second and following centuries, and the light of the gospel was communicated to the Gauls, to Spain, and to Great Britain; Germany and the north called forth their exertions in the middle ages; and America, with its islands, on one side, and on the other the East Indies with China, and their dependencies, have in later times afforded increasing employment. Of all the regions, comprised under these appellations, there is scarcely one that has not been visited by their missionaries, and of all the nations which inhabit them there is scarcely one tribe among whom converts have not been made. This grand and extensive plan of Christian conquest is supported by several establishments at Rome. One of these establishments is a noble seminary, called, from its object, the Collegium de Propaganda Fide. It has a magnificent library, and a press, in which have been printed books in every known language; but all the types, amounting to thirty-six sets, appropriated to so many different languages, were carried off by the French previous to their Egyptian expedition, and whether they have been restored or replaced by others since the overthrow of the Bonapartean dynasty, is not known. Besides the expenditure of the Roman court for the propagation of Christianity, other burdens fall upon it, namely, the keeping in repair all the public edifices, especially those immense palaces, which, though of little use as residences, are the receptacles of all the wonders of ancient and modern art; the protecting from farther dilapidation the remains of Roman magnificence; the expense of supporting the drainage of the Pontine marshes, and also of embellishing and improving the capital and its territory. If, in addition to all these burdens, be taken into account the pensions frequently bestowed by the Roman pontiff on poor bishops, and the claims upon his charity from every part of Europe, the difficulties under which the papal treasury laboured towards the close of the late pontiff's reign, will not be matter of surprise.

The pope, as we have already said, is both bishop and prince. But it is to the first of these characters that his titles, dress, equipage, and the whole ceremonial of his court, are adapted. In his own court he receives the appellation of Holiness, or the Holy Father, in reference to his peculiar duties and functions; but the pope is sometimes styled Sovereign Pontiff, by historical writers. Excepting the stole, and the colour, which is white not purple, his robes do not differ from those of a bishop in pontificals, and his vestments, when he officiates in church, as well as his mitre, resemble those of other prelates. It is probable that the tiara was originally an ordinary mitre, such as the Greek patriarchs still wear. Of the three circlets which have raised it into a triple crown, the first or lower appears to have been a mere border, gradually enriched with gold and diamonds, the second was the invention of Pope Boniface VIII. about the year 1300, and the third was added about the middle of the fourteenth century; they are said to have been added for different mystic reasons. As the pope uses the common episcopal mitre in most great ceremonies, he employs the tiara only on certain extraordinary occasions. At all times he appears encircled with reverence and with majesty. When he appears in public a large silver cross raised on high, is carried before him as a sacred banner, the church bells ring as he passes, and all kneel in his sight. When he is to officiate at the patriarchal Basilicae, he is carried in a chair of state from his apartments in the adjoining palace to the church, though in the chancel his throne is merely an ancient episcopal chair, elevated a little above the seats of the cardinals or clergy. The pontifical palaces being vast and magnificent, and the apartments numerous, the approach to his person in private is perhaps not surpassed for appearances of grandeur. There is always waiting in his anti-chamber a prelate dressed in full robes; and when the door of the pope's apartment opens, at the ringing of the bell, he is seen in a chair of state with a small table before him. It is a common practice for the person presented, to kneel, first at the threshold, next, in the middle of the room, and then at the pontiff's feet, who, according to circumstances, allows him to kiss the cross embroidered on his shoes, or presents his hand to raise him, after which he condescends to converse with him a short time, and dismisses him with some slight present of beads or metals, as a memorial. As the individual retires, he again kneels religiously, and the doors are at length closed. The pope may be said to labour under the weight of his dignity, for he is always encumbered with the same robes, surrounded by the same attendants, and confined within the magic circle of etiquette. Indeed, it may be reasonably supposed that the want of relaxation must depress his spirits, and induce him to sigh for the leisure and insignificance of the college or the cloister. A morning of business and application concludes with a solitary meal; his only exercises are a walk in the gardens of the Quirinal or Vatican, or a visit to a church or an hospital; and, as he never dines in company, a repast to him can be no recreation. Both in public and private, the person and conduct of the pope are ever under restraint and inspection. In the Papal court there is a joyless uniformity, and a strict decorum pervades every apartment immediately connected with the person of the pontiff.

Our attention must now be directed to the election of the Roman pontiff. In the manner of choosing him, there have been some varieties in different ages, as there may be alterations made in discipline; yet the Roman Catholic clergy have, very properly, had the chief part in that election, and that clergy is represented by, or in some measure consists of the cardinals, of whom it will, therefore, be proper here to give some account, though we have already noticed them in the order of the alphabet. When the sacred college is complete, the cardinals, or principal persons of the Romish church, amount to seventy. Of these, six are cardinal bishops; fifty are cardinal priests, who enjoy titles from parish churches in Rome; and fourteen are cardinal deacons, who have their titles from churches in Rome, of less note, denominated deaconries. Originally the title of cardinal was given to the parochial clergy of Rome; and this title probably was taken from the imperial court, where, in the time of Theodosius, the principal officers of the state received that appellation as a distinction to their respective dignities. The dignity and importance of the cardinals increased with that of the Roman see itself, and they shared alike its temporal as well as its spiritual pre-eminence. Cardinals are commonly chosen from among such clergymen as have borne offices in the Roman court; some are assumed from religious orders, and eminent ecclesiastics of other countries are also sometimes honoured with this dignity. Their distinctive dress is scarlet, to signify that they ought to be always ready to shed their blood for the faith and church, when the defence of either require it. They wear a scarlet cap and hat, which they receive from the pope; the former is sent to them if they are absent from Rome, but the hat can only be obtained from the pope's own hand. As the cardinals are the councillors, so they are the officers of the pope, so that they are entrusted with the management of the church at large, and of the Roman state in particular. In their grand assembly, or consistory, as it is called, where the pope always presides in person, they appear in all the splendour of the purple, and constitute a very majestic senate. It must be observed, however, that this assembly is not precisely a council, as their business generally is to ratify measures that have been previously weighed, and decidedly approved of in the pope's cabinet. In the consistory, public communications are announced, foreign ambassadors received, cardinals created, formal compliments made and answered; and, in a word, the exterior splendour of sovereignty is fully displayed. The cardinals are divided into different congregations for the more easy dispatch of business. Some of them have the chief offices in the pontifical court, as that of cardinal-vicar, — penitentiary, — chancellor, — camerlingo, or chamberlain,—prefect of the signature of justice—prefect of memorials,—and secretary of state; and the title of "eminence" or "most eminent," is conferred upon them. The principal and most honourable privilege of the cardinals is that of electing the pope, and it is in the conclave, so called because the members of which it is composed are shut up within the precincts of the great halls of the Vatican for the purpose of electing a pope, that this preregative is exercised. On the demise of a pope, his pontifical seal is immediately broken by the cardinal chamberlain, and all public business that can be delayed is interrupted; messengers are dispatched to all the catholic sovereigns, to inform them of the event, that the cardinals in their dominions may, if they think proper, hasten to the future election; whilst the whole attention of the sacred college is turned to the preservation of tranquillity in the city and state, and to the preparatory arrangements for the election. After having gone through the usual ceremonies of knocking three times with a gold hammer at the door of the deceased holy father, calling him each time by his Christian family and papal names, and breaking with the same hammer the fisherman's ring, the cardinal chamberlain takes possession of the Vatican in name of the apostolical chamber. He sends guards to take possession of the gates of the city, and of the castle of St Angelo. Having thus provided for the safety of Rome, he quits the Vatican in a carriage, preceded by a captain of the pope's guard, and having by his side the Swiss guards, whose duty it is to accompany the pontiff. At the commencement of the march, the great bell of the capitol is tolled to announce to the whole city the death of the sovereign pontiff, it being never tolled on any other occasion. The body of the deceased pontiff is carried to St Peter's, where funeral service is performed for him with great pomp during nine days, after which the burial takes place. All necessary preparations are in the mean time made for the ensuing election, and the place where the cardinals assemble for that purpose, is fitted up in that part of the Vatican palace which is nearest to the church of St Peter. The large rooms of that palace are divided by temporary partitions into what are called cells, which are subdivided into little rooms and closets. The cells are lined with cloth, and a number is put upon each of them. To each cardinal is allowed two, and to a cardinal prince three attendants, who carry in their master's meals, serve him at table, and perform all the offices of a menial servant. On the tenth day after the death of the pope, the cardinals who are then at Rome assemble in the chapel of St Peter's, called the Gregorian chapel, where a discourse is delivered on the proper choice of a pontiff, and mass is said for invoking the grace of the Holy Ghost, after which they proceed to the conclave in procession two by two. When all is properly settled, the conclave is shut up, and strong guards are stationed around. The only communication with the exterior is by means of towers the same shape as those in convents of nuns; but a door is kept for the removal of any cardinal who from indisposition may be obliged to retire, and thus forfeit the right of giving an active vote. Every cardinal at the commencement of the conclave signs a paper, containing an obligation that, in the event of his being elevated to the papal chair, he will not alienate any part of the pontifical dominion; that he shall not be prodigal to his relations; and any other stipulations framed for the occasion. Secret ballot is the mode of election now in use. In the chapel of Sixtus a long table stands whereon are placed two chalices for receiving the bulletins of the cardinals, containing the name of the person to whom they give their vote. The name is read aloud by one of the curators, and two others mark the number of votes for each person by the side of his name on the large tablet containing the names of all the cardinals; and he who has the success to obtain two-thirds of the votes present is canonically elected, and has his name immediately proclaimed aloud, while the cardinals situated on his right and left rise and quit their places. His consent being then obtained, the cardinals, beginning by the oldest, perform the ceremony of kissing his foot and then his hand. On the announcement of the election by the first cardinal deacon, the news is spread afar by means of the artillery of the castle of St Angelo, and the bells of the city; and the people are then allowed to rush into the conclave, and carry off whatever they can obtain. There are certain reasons for exclusion from the pontificate, and many circumstances concur to prevent or promote an individual to it, arising chiefly from the numerous factions into which the sacred college is divided. The person proposed must be under fifty-five years of age; he must be a prince by birth, or be allied to a reigning house, lest such a pope should dismember the patrimony of St Peter, in order to invest some members of his family with it; and he must have been promoted to the degree of cardinal at the nomination of some crown, especially that of France and Spain, or be a neutral-born subject of either of these powers. The following observations respecting the ceremonies accompanying the election of the pontiff, from the author already quoted, shew that all Romanists are not insensible of the corruption of their hierarchy: "It is not my intention to specify all the forms of etiquette observed, or the ceremonies practised during the process, or at the conclusion of the election; two or three, however, I must notice, for reasons which will appear sufficiently obvious; one is the custom of putting the tickets containing the votes of the cardinals on the patina, or communion plate, and then into the chalice: now, however important these votes may be, and however intimate the connection with the welfare of the church, yet, to apply the vases devoted in a peculiar manner to the most awful ceremonies of religion, seems to pass beyond disrespect, and almost to border on profanation. The next ceremony to which I have alluded is that called the adoration of the pope: it takes place almost immediately after his election, when he is placed in a chair of the Sextino chapel, and there receives the homage of the cardinals; this ceremony is again repeated on the high altar of St Peter's. Now, in this piece of pageantry, I object not to the word adoration; no one who knows Latin, or reflects upon the sense which it bears on this and on a thousand other occasions, will cavil at it, though he may wish it otherwise applied: nor do I find fault with the throne; he who is at same time both pontiff and prince, has, from time and custom, perhaps, a double title to such a distinction. But why should the altar be made his footstool? The altar, the beauty of holiness, the throne of the victim lamb, the mercy-seat of the temple of Christianity; why should the altar be converted into the footstool of a mortal?" See Eustace's *Classical Tour through Italy*, a work to which we acknowledge our obligations for much of our information respecting the Roman pontiff.

POPE, Alexander, a distinguished British poet, was born in 1688, of an ancient family in London. From his youth he was of a constitution tender and delicate; but when about seven years of age, he evinced a strong predilection for books. He was instructed in the elements of learning by an aunt, and, after studying Latin and Greek under a Romish priest of the name of Taverner, he was sent to a Roman catholic seminary at Winchester, whence he was removed to a school at Hyde-Park Corner. At an early period of life he evinced a talent for versification, in which he was confirmed by the perusal of Ogilvy's Translation of Homer, and Sandy's Translation of the Metamorphoses of Ovid. When at the school at Hyde-Park Corner, he used occasionally to visit the playhouse, and was so charmed with theatrical exhibitions, that he was led to draw up a kind of play from Ogilvy's Homer, with some verses of his own intermixed, which his school-fellows acted, with the addition of his master's gardener, who performed the character of Ajax. About the time of the revolution, his father, who was a Roman catholic, quitted the profession of a hatter, and retired to Binfield in Windsor Forest, where he had purchased a house and a few acres of land. Here he lived comfortably on a capital of L.20,000, a great part of which was consumed before his son came to the inheritance. Our poet was twelve years of age when his father called him to Binfield. He then became acquainted with the works of Spencer, Waller, and Dryden, of the latter of whom he was led to form a very high opinion. At his urgent request, some friends took him to the coffee-house which Dryden frequented, in order that he might have the gratification of obtaining a sight of the poet. With Dryden, however, he never became acquainted, a misfortune which is happily expressed in his phrase *Virgilium tantum vidi.*

Among Pope's earliest productions was his Ode to Solitude, written at the age of twelve, which exhibits no peculiarity of poetical talent, and is perhaps scarcely equal to Cowley's performances at the same age. When he was only fourteen years of age, he amused himself with translating the classics, and the translation he then executed of the Thebais and of Sappho to Phaon, indicate considerable progress in his career. In his fifteenth year, he commenced an epic poem named Alcander, which production he afterwards shewed to Atterbury, and expressed his intention of burning it; a punishment in the justice of which his friend concurred, but, at same time, advised him to spare the first page, and place it among his curiosities. Of himself, Pope observes, "There was a time when I was in love with myself; and my first productions were the children of Self-love upon Innocence. I had made an epic poem and panegyrics on all the princes, and I thought myself the greatest genius that ever was.

I cannot but regret those delightful visions of my childhood, which, like the fine colours we see when our eyes are shut, are vanished for ever."

The Pastorals of our author, begun in 1703, procured him great reputation, and were the means of introducing him to the notice of the wits and critics of the age, among whom were Wycherley and Walsh. His Ode on St Cecilia's day, and the first part of his Windsor Forest, were composed about the same time; and in 1708 he wrote the Essay on Criticism, which evidently shewed that his genius was of no ordinary cast. He next wrote his much admired Elegy on an Unfortunate Woman, which has been supposed to refer to some lady for whom he had conceived an attachment. The Rape of the Lock, which was first completely published in 1712, stamped the reputation of Pope as an inventive poet. This sprightly, ingenious, and amusing performance is admired by Johnson for its originality, though it must be admitted the subject is trifling and frivolous. It was occasioned, he informs us, by a frolic of gallantry rather too familiar, in which Lord Petre cut off a lock of Mrs Arabella Fermor's hair, which was so much resented that the commerce of the two families, before very friendly, was interrupted. Pope was urged by a familiar friend to endeavour a reconciliation by a ludicrous poem, which might bring both the parties to a better temper; and the event is said to have been such as was desired—the pacification and diversion of all to whom it related. About the same time he published his Temple of Fame, which was followed in 1713 by his Windsor Forest.

Our author now thought of obtaining emolument as well as praise by his literary labours, and accordingly circulated proposals for publishing a translation of Homer's Iliad by subscription, which project succeeded astonishingly, so that the first volume, containing the first four books, was given to the world in 1715. It is worthy of remark, that the subscription rose to L.6000, which, with L.1200 which Pope received from Lintot for the copy right, at once relieved him from those pecuniary difficulties which he had hitherto experienced, and secured his future life from want. He was now enabled to purchase a house at Twickenham, to which he removed with his father and mother in 1715. He lost his father about two years afterwards, but his mother long survived, cheered by the affectionate care and attention of her son.

Shortly after the publication of the first volume of the Iliad, a rival translation appeared, which was supposed to be done by Addison, whom Pope, therefore, attacked in a piece of satire, which had the effect to extinguish all farther opposition. The friendship which had subsisted between them was thus brought to a termination by mutual jealousy, and they never after shewed more than civility to each other.

In 1717, Pope, with the view of improving his fortune, collected his separate works into one quarto volume, to which he prefixed an admirable preface; and in 1721, he published an edition of Shakespeare, which, instead of doing him credit, raised him many enemies, and exposed him to much severity of criticism. Shortly after the completion of the Iliad in 1720, he issued proposals for a translation of the Odyssey, and engaged Broome and Fenton for the sum of L.500 to assist him in the undertaking. Only twelve books of the Odyssey were translated by Pope himself, and all the notes were written by Broome. The other twelve, written by his assistants, are considered much inferior to those done by our author himself. Pope was much gratified, however, with a criticism on the work from the pen of Mr Spence, then prelector of poetry at Oxford, which was written with much coolness and candour. The Odyssey was published in the same manner, and on the same conditions to Lintot as the Iliad, excepting that, instead of L.1200, he had but L.600 for the copy.

Mr Pope had composed his exquisite Epistle from Eloisa to Abelard some years previous to his publishing the poems of Parnell, which appeared, with a dedication to the Earl of Oxford, in 1721.

In the life given of Lady Mary Wortley Montague in this work, we have alluded to the inveterate enmity that subsisted between that eminent individual and our author. While Lady Mary resided in the village of Twickenham, in the house of Sir Godfrey Kneller, Mr Pope paid his respectful addresses to her, and she deigned to enter into a sort of intimacy with him, from a conviction, perhaps, that there was no risk of scandal from a poet, and especially from one of his indifferent personal appearance. During Lady Mary's residence abroad, the poet carried on a familiar correspondence with her; but, after her return to England, circumstances occurred, both of a personal and political nature, which set them irreparably at variance with each other. About the year 1725, Pope associated with Swift and Arbuthnot in the publication of a volume of Miscellanies; in which was first inserted ΠΕΡΙ ΒΑΘΟΥΣ, or Martinus Scriblerus his treatise of the Art of Sinking in Poetry. In this curious production, our poet illustrated his ironical precepts by examples, and gave a classification of bad poets, and also ridiculed various living authors, who, in return, attacked him abusively. According to Pope's own account, the war in which he was thus plunged gave occasion to the Dunciad, which appeared in 1728, with notes by Swift, under the name of Scriblerus. This poem, which seems to have been composed with the greatest care and labour, is often stained with coarse invective and offensive raillery; and it must be admitted, that several of the individuals which it brought into notice would have inevitably sunk into oblivion, but for the enmity of their great opponent, which has conferred upon them a species of immortality which they scarcely merited.

Some years before the publication of the Dunciad, Pope narrowly escaped losing his life, as he was returning home in a friend's chariot, which, on passing a bridge, was overturned, and thrown with the horses into the river. As he was unable to break the glasses, he would assuredly have been drowned, had not the postillion broken them, and dragged him out to the bank. By a fragment of the glass, however, he was so severely cut in the hand that he lost the use of two of his fingers.

Mr Pope, at the suggestion of Lord Bolingbroke, directed his attention to moral subjects, and engaged in the Essay on Man; a poem deemed by Lord Kaimes the best of his works, though not so favourably thought of by Dr Johnson. Of this piece the subject is very grand, and the poetry, on many occasions, is both sublime and beautiful. Bolingbroke, it is generally supposed, furnished the outlines of the essay in prose; and Pope, having the fullest confidence in his "philosopher" and "friend," versified what he had received, without, perhaps, completely understanding its nature or perceiving its tendency. Though there is unquestionably much to be praised, and little to be blamed in the Essay on Man, yet, in the perusal of it, the reader is not always satisfied. It is not easy, sometimes, to see the tendency of the poet's reasonings, and he is often embarrassed, and scarcely intelligible. The mind is filled with imagery, and involved in a blaze of eloquence; but, in some instances, the closer we examine the point in hand, it grows more obscure. Darkness thickens the more it is studied. From the abstractions into which he is led, his genius is hampered and confined; but when he gets at a distance from these, he flows with great melody. He is always eloquent when he illustrates; always perspicuous when he amplifies. It then appears, that he is no less eminent for strength of judgment than splendour of imagination. In all his digressions there is much sweet and spirited poetry. On the episodes in the work the mind delights to be detained. These support its reputation, and are treasured up in the memory by all readers of taste. Here every thing comes with grace from his pen, and we regret that our pleasure may soon be interrupted by what we do not understand, or what is merely conjectured.

Some time after the Essay appeared, it was accused of naturalism, or a train of thought, excluding revealed religion, and supposed to lean to the optimism of Leibnitz, or a system of fatalism, in which, if not God, angels and men, mind and matter, are involved. On these grounds, it was opposed by Crousaz, an acute logician of Geneva, and defended by Warburton with a great deal of abuse but little argument. However bold, therefore, and original the poetry may be, the doctrines are sometimes very questionable or absurd. To unravel the scheme of the universe is a very daring task, but not to be executed by our limited comprehensions. Some notion of it may be obtained by probable conjecture, or analogical reasoning, but to give any theory, unsupported by facts, must be rash and presumptuous. We must confine our ingenuity to a much more limited range, if we would turn it to account. To expand the simple dictates of nature, to descant upon our moral feelings, and open up the sources of moral obligation, will be highly instructive; but pure metaphysics rack the judgment, and confound the imagination. By wading through obscure and inexplicable abstractions, we are entangled and stupified, but not warmed or enlightened. These Pope has not been able to avoid in his essay; and Johnson has rightly said, that in none of his works are there so many harsh and rugged lines, or so many thoughts awkwardly or imperfectly expressed.

It appears that the success which attended his productions induced our poet to publish his Imitations of Horace, his Epistles and Essays, and other works of a moral and satirical nature. The year 1732 deprived him of his much esteemed friend Gay; and in the following year he lost his mother, who died at the advanced age of 93. Curl the bookseller having published surreptitiously the private correspondence of the poet, he conceived the idea of giving to the world a genuine collection, which accordingly appeared in 1737 in quarto. It was published by subscription, and has always been considered as a great acquisition to our epistolatory literature. Pope's last satires of the general kind were two dialogues, entitled *Seventeen Hundred and Thirty-eight*, from the year in which they were published. These he wrote under the influence of the patronage of the Prince of Wales, who was then in avowed opposition to the measures of his father's ministers.

A fourth book was added to the Dunciad in 1742, and the whole poem was published complete in the following year.

Pope had all his life been subject to a constitutional headache, which was now increased by a dropsy in his heart, which put a period to his existence on the 30th of May 1744, in the 56th year of his age. His remains were interred at Twickenham, where a monument was erected to his memory by his commentator, the bishop of Gloucester. Mr Pope died as he received extreme-unction. It is probable, from his not having sufficiently attended to his religious faith and principles, that he was almost in the state of that French nobleman, mentioned in a French miscellany, called Ana, who, at the requisition of his wife, sent for a priest; and when the priest asked him whether he believed such and such particular article, he turned to his wife, and said, "My dear, should I believe that?" Mr Pope, indeed, in one of his letters to Atterbury, the bishop of Rochester, talking of his reading books of controversy on religious subjects, says, "At the age of seventeen I warmed my head with them; and the consequence was, that I found myself a Protestant and a Papist by turns, according to the last book I read."

By his will, of date December 11, 1743, Miss Martha Blount, a lady to whom he was much attached was made his heir during her life; and the property of all his works was bequeathed to Mr Warburton, who, in 1751, published a complete edition of all Mr Pope's works, in nine volumes 8vo.

The character of Pope has been differently represented by Lord Orrery and Dr Johnson. But, indeed, it must be admitted, that the indulgence and accommodation which the state of his health rendered indispensable, occasioned in him a fretfulness of disposition and a shortness of temper which were not indigenous to his great mind. Impressed with all the unpleasing and unsocial qualities of a valetudinarian, he imagined that to his ease or humour every thing should give way. Dr Johnson says of him, that his parsimony appeared in a niggardly reception of his friends and a scantiness of entertainment, but that he was capable of generous and elevated sentiments. Of his intellectual powers, he observes, "As a poet, admitting that he was deficient in in-

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vention, his claim to pre-eminence on other qualities will scarcely be disputed; and it will be generally admitted, that no English writer has carried farther correctness of versification, strength and splendour of diction, and the truly poetical quality of adorning every subject that he touched." An able essay on the genius and writings of Pope was published, in 1756, by Dr Warton, in 2 vols. 8vo.; and it was subsequently reprinted in 1806.

POPERY, from the word Pope, properly implies the religious doctrines and practices of the Roman Catholics. The tenets of the Romish church have been variously represented by different writers, and all in communion with the see of Rome have been branded with the appellation of Papist, owing to their belief in the supremacy of the Roman pontiff, who, in the Western church, was anciently called by the name of pope. But it should be remembered, that opinions, whether regarding belief or practice of particular schools, or of particular divines, constitute a distinct and separate object. In the forming of such opinions great latitude is allowed, which is consequently often liable to be abused. Some men have had it in their power to give an undue weight to such opinions; and Catholics themselves have been sometimes imposed upon from the inventions of fallible men being ignorantly confounded with the unerring declarations of heaven; a circumstance of which the enemies of Catholics have certainly taken an unfair advantage to the prejudice of the Catholic faith. Christians of all denominations ought to endeavour to understand one another better than they have hitherto done; and, instead of supposing imaginary differences, strive to remove real ones, for the general good of mankind and the honour of religion; and all ought to vie with one another to excel in just and honourable sentiments, language, and behaviour. "We are accused," says an able Catholic writer, "of great uncharitableness in allowing salvation to none but Catholics.—But this is a mistaken notion. We say, I believe, no more than all other Christian societies. Religion certainly is an affair of very serious consideration. When, therefore, a man either neglects to inform himself, or, when informed, refuses to follow the conviction of his mind, such a one, we say, is not in the way of salvation. After mature enquiries, if I am convinced that the religion of England is the only true one, am I not obliged to become a Protestant? In similar circumstances, must not you likewise declare yourself a Catholic? Our meaning is, that no one can be saved out of the true church; and as we consider the evidence of the truth of our religion to be great, that he who will not embrace truth, when he sees it, deserves not to be happy. God, however, is the searcher of hearts; he only can read those internal dispositions on which rectitude of conduct alone depends. Such are the answers we have always given to this, and to other charges. We know, we have had amongst us many bad and weak men, who have often spoken and often acted wrong; but it is unfair to involve the innocent in the ways of the guilty. By this *ordeal*, the virtues and good qualities of every society upon earth would be utterly done away. As Christians, therefore, we admit all the doctrines of divine revelation; as Catholics, we submit our faith to the authority of that church, which we think Christ has founded; as men, we profess our obedience to the moral precepts of reason and nature; and as subjects, the king has our allegiance, the laws our reverence, and the state may command our services."

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Nothing can be more preposterous than to impute to the present Catholics the persecuting and domineering spirit of their forefathers. All churches having power, are too apt to abuse it in matters of religion. Mr Pitt, in the year 1788, requested to be furnished with the opinion of the Catholic clergy and foreign universities on certain important points.—Three questions sent to the universities of Paris, Louvain, Alcala, Douay, Salamanca, and Valadolid, were thus unanimously answered—1. That the pope, or cardinals, or any body of men, or any individual of the church of Rome, has not any civil authority, power, jurisdiction, or pre-eminence whatsoever within the realm of England. 2. That the pope or cardinals, &c. *cannot* absolve or dispense with his Majesty's subjects from their oaths of allegiance, upon any pretext whatsoever. 3. That there is no principle in the tenets of the Catholic faith by which Catholics are justified in *not* keeping *faith with heretics* or other persons differing from them in religious opinions, in any transactions either of a public or a private nature. To these replies must be added, that the declarations signed by *the English, as well as Scotch Catholics*, in 1789, is to the same purpose, and most unequivocally expressed. The present Roman catholics disavow all manner of persecution; indeed, they profess to acknowledge the principles, and to admit, in its full extent, the claims of religious liberty. Some Roman catholics, renouncing the supremacy of the pope, distinguish themselves by the name of Catholics, and sometimes of Catholic dissenters. Of this number was the ingenious and learned Dr Alexander Geddes.

Upon the whole, it may be remarked with confidence, that men of every description begin to perceive, that whatever absurd tenets or practices attach to any party, they are not on this account to be deprived of their religious freedom. The time, indeed, is at length arrived when Catholic and Protestant seem to be agreed, that the spirit of persecution is not the spirit of Christianity.

But referring the discussion of the doctrines and practices of the Romish church to the article RELIGION, we shall under this head confine ourselves merely to an historical sketch of the rise, progress, and decline of popery, tracing the steps by which the Roman pontiffs gradually acquired civil possession, till at length they assumed the rank of princes.

Christianity, on its first appearance in the Roman empire, was deemed unworthy of the notice of the magistrate and the philosopher, and viewed as a mean and idle superstition, which was merely a matter of dispute among the Jews themselves. The Christians, however, gradually increased in numbers, till at length their suppression was contemplated by the priesthood and the magistracy; yet, notwithstanding the severity with which they were persecuted from time to time during the reigns of the pagan emperors, they at length diffused themselves through all ranks of society, and acquired a high influence even in matters of state and government, insomuch that the Roman emperors began to see the propriety of conciliating their favour. Identifying with his own interests those of the most powerful body in the empire, Constantine the Great decreed the abolition of paganism and the establishment of Christianity as the religion of the empire, and thus produced an entire change on the whole of the Christian profession. The Christians were now freed from persecution, and permitted to bask in the sunshine of worldly prosperity. But instead of continuing in the integrity of their profession, they, in a great measure, forsook that gospel which had formerly been the main source of their consolation and support, and became depraved in their morals and litigious in their tempers. By conferring the highest honours and privileges on the clergy, Constantine confirmed in them the spirit of this world, the spirit of pride, avarice, domination, and ambition. The leading men now began to new-model the church, the government of which was, as far as possible, arranged conformably to that of the state. The title of bishop was assumed by the emperor, who, with his constituents, convened councils and determined all matters of discipline. The bishops corresponded to those magistrates whose jurisdiction was confined to single cities; the metropolitans to the pro-consols or presidents of provinces; the primates to the emperor's vicars, each of whom governed one of the imperial provinces. Canons and prebendaries of cathedral churches had their origin from the societies of ecclesiastics which Eusebius, bishop of Verceil, and after him Augustine, formed in their houses, and in which these prelates were called fathers and masters. Thus the hierarchy established by Constantine was altogether a complete departure from the simplicity of the primitive church.

It is not a little curious to trace the steps by which the usurpations of the hierarchy attained their height. The distinction between the bishop and his assistants having been made sufficiently obvious, an idea then began to prevail that these assistants were only the representatives of the bishop, deriving their powers from him exclusively, and subject to his control in the exercise of those powers. The functionaries in question were ordained by him, and were tried, in what may be denominated even at this early period, his consistory court. In the disposal and use of the property of the church, which remained for ever at his disposal, he did not fail to promote his own selfish views. The bishops residing in large towns effected the next step by their aspiring at power and authority. Ecclesiastical assemblies were commonly held in large towns; and at these assemblies, the bishop on the spot was usually chosen preses—an office which, once attained, was afterwards claimed as a right. Thus the bishop once upon a level with his presbyters, or at most upon a level with his brethren of the episcopate, would be established, in precedence and importance, as the metropolitan of the province to which he belonged. A fair opportunity then offered of extending and confirming his powers; he soon became a patriarch, and was at length made a pontiff. The papacy, however, appears to have been the result of other circumstances and considerations besides what we have just mentioned. It had been observed, that, in the enumeration of the apostles given in the Sacred Volume, Peter held the first place, on account perhaps of his age and personal respectability, and that this apostle is represented by Christ himself as the rock on which the church should be founded, or, in other words, that the religion of Jesus should, through Peter's ministry and apostolical labours, be established in the world. Now the supposition was formed by the bishop of Rome and his adherents, that the first or principal place was allotted to the apostle Peter, not in consideration of his years and his personal respectability, but on account merely of those powers and dignities which our Saviour bestowed upon him. They, accordingly, maintained the doctrine that he was the rock on which the church was founded; and thus, in their zeal for their own aggrandisement and interest, they forgot the declaration of Scripture, that the church is built on "the apostles and prophets" generally, "Jesus Christ himself being the chief corner stone." It would be of little avail, however, to invest St Peter with powers and dignities, unless the bishop of Rome could prove himself to be his legitimate successor. In order, therefore, to establish his title as successor, tradition was had recourse to, by which they affirmed, that the see of Rome was founded by the apostle alluded to, and also that the powers originally conferred upon him had descended by regular devolution upon his successors in office. Though it does not appear from any historical document that St Peter ever visited Rome, the tradition of his having been the founder of the holy see was duly supported, and the inference was drawn from it, that the bishop of Rome, like St Peter himself, was the rock on which the church was built, the foundation and basis of the whole superstructure, without which it could not stand together for a moment, but must fall into ruins. The powers of the church were invested in him alone, laid up, as it were, and condensed in his sacred person. If others were the branches, he was the root; if others might be allowed to call themselves the streams, he was the fountain for the supply of the whole. He was, in a word, constituted by Jesus Christ himself the supreme legislator and judge of the universal church, and all bishops, metropolitans, and patriarchs, were subject to his authority, and dependent on his sovereign will. Though this conclusion was acknowledged to be a sweeping one, the premises were received as good, and the consequence appeared to be unavoidable. The patriarch of Constantinople laboured in vain to maintain his right and privilege in opposition to the pope, by asserting, that other churches, besides that of Rome, were founded by St Peter, one of which, by the consent of all antiquity, was the church of Antioch; for the claims of the Byzantine church were never thoroughly established, and its pontiff gradually sunk into the second place.

On this subject, Dr Mosheim says, "A bishop, during the first and second centuries, was a person who had the care of one Christian assembly, which, at that time, was, generally speaking, small enough to be contained in a private house. In this assembly he acted not so much with the authority, as with the zeal and diligence of a faithful servant. The churches, also, in those early times, were entirely independent; none of them subject to any jurisdiction, but each one governed by its own ruler and its own laws. Nothing is more evident than the perfect equality that reigned among the primitive churches; nor does there ever appear, in the first century, the smallest trace of that association of provincial churches from which councils and metropolitans derive their origin. To which may be added, that the first churches acknowledged no earthly potentate at their head. This had been expressly prohibited by their divine master; but the excellent maxims of the New Testament were disregarded by those who undertook to new-model the constitution of the Christian church under the auspices of Constantine, and whom, as a matter of courtesy, they condescended to make its earthly head. It cannot be a subject of surprise, therefore, that when Christianity had thus been corrupted, the bishop of Rome began to be distinguished by a pre-eminence over other prelates. Prejudices arising from a great variety of causes contributed to establish this superiority, but it was chiefly owing to that grandeur and opulence by which too many professors of Christianity form ideas of pre-eminence and dignity, and which they generally confound with the reasons of a just and legal authority. The bishop of Rome surpassed all his brethren in the magnificence and splendour of the church over which he presided; in the richness of his revenues and possessions; in the number and variety of his ministers; in his credit with the people, and in his sumptuous and splendid manner of living."

The progress of papal power and papal superstition, have ever kept pace. In the fourth century, the religion of the Greeks and Romans differed very little in its external appearance from that of the Christians. Both had a pompous and splendid ritual, and gorgeous robes, mitres, tiaras, wax tapers, crosiers, processions, lustrations, images, and gold and silver vases, were equally to be seen in the heathen temples and in the Christian churches. On the abolition of paganism by Constantine the Great, superb churches, adorned with pictures and images, were erected and consecrated with great pomp, and with certain rites chiefly borrowed from the ancient laws of the Roman pontiffs. Many rites and ceremonies were invented to embellish the Gospel, and the love of human applause and desire of worldly grandeur was manifested to a great degree. The sermons addressed to the people were in general little adapted to enlighten the understanding or improve the heart, and an air of folly and extravagance seemed to pervade the Christian assemblies. During the fifth century, that church, which was professedly the church of Christ, instead of being filled with love and the fruits of the spirit, presented a scene of deplorable contention; but, among the contending factions, the Roman pontiff alone found the occurrences of the times favourable to his ambition. He had not yet assumed the dignity of supreme lawgiver and judge of the whole Christian church, but various circumstances concurred to augment his power and authority. When the bishops of Alexandria and Antioch found themselves unable to withstand the lordly prelate of Constantinople, they fled for succour to the Roman pontiff; and the inferior bishops, when their rights were invaded by the prelates of Alexandria and Antioch, also fled to him; and thus accessions were quickly made to the influence and authority of the Roman see. By such means he was enabled to extend his dominion in the east; but in the west his success proceeded from other causes. Owing to the supine indolence of the emperors, the bishop who presided in their imperial city maintained an almost uncontrolled authority; while, to his rising dominion, the measures and triumphs of the barbarians were favourable, rather than otherwise, to its advancement. The kings who penetrated into the empire, concerned themselves only about the affairs of government, and perceiving the subjection of the multitude to the bishops, and the dependence of the bishops upon the pope, they loaded him with various benefits and honours, as an effectual means of promoting their own interests.

None of the prelates who ruled the Romish church during the fifth century, maintained the authority and pretensions of the Roman pontiff so successfully as did Leo the Great, during whose pontificate the fourth general council was held, in which the famous canon was enacted, that rendered the see of Constantinople, in all respects excepting precedency, equal with that of Rome,—a measure which provoked him exceedingly, and which he vehemently opposed, but with little effect.

The history of the church of Rome from the time of Leo till the close of the sixth century, is remarkable only for the increasing wickedness and superstition of its members, both clergy and laity. The claims to supremacy which, during the preceding centuries, had been asserted by the bishops of Rome, were at first faintly urged, and were by artful means gradually strengthened. But they now began to insist upon superiority as a divine right attached to their see, which they asserted had been founded by the apostle Peter; and so powerful was the influence of the papal intrigues, that there were few among the princes of the western empire who were not virtually brought into a state of subjection to their authority. The peace of the Catholic church was thrice disturbed during the 6th century, by the contests and squabbles of the bishops for superiority. The discordant claims of Symmachus and Laurentius, who had been elevated to the vacant see by different factions, continued to be asserted for several years, and the former was at length successful. Another clerical war ensued respecting the claims of Boniface and Dioscorus, which came to a speedy termination owing to the death of Dioscorus. A similar disturbance was occasioned by a prelate named Vigilius, who effected the downfal of Silverus the reigning bishop, and, through his artifices at court, caused him be confined in the islands of Pontus and Pandatara, where he died.

In the year 588 a Constantinopolitan prelate, of the name of John the Faster, laid claim to authority similar to that of the bishop of Rome, and took upon himself the title of universal bishop; and no sooner was he confirmed in this title than he was opposed by Pelagius II. then bishop of Rome, who denounced invectives against a procedure considered by him execrable and profane. Under the reign of Gregory the Great, which commenced in 590, the Arians of Italy and Spain were reconciled to the Catholic church. This pontiff sent 40 monks to Britain, and two years afterwards was able to announce to the archbishop of Alexandria the baptism of the king of Kent with 10,000 of his Anglo-Saxons. No small reputation was attained by Gregory, owing to the visions and pretended miracles which his credulity or prudence induced him to hold forth in confirmation of the truths of religion. It may not be improper here to give an extract from his letter to the emperor Maurice, at Constantinople, respecting the circumstance of John the patriarch of that city having assumed the appellation of universal bishop, as it casts considerable light upon the history of that age. "Every man that has read the gospel knows, that even by the very words of our Lord, the care of the whole church is committed to St Peter the apostle, the prince of all the apostles; and yet he is not called universal apostle, though this holy man, John, my fellow priest, labours to be called universal bishop! I am compelled to cry out, O the corruption of times and manners! Behold the barbarians are become lords of all Europe; cities are destroyed, castles are beaten down, provinces depopulated, there is no husbandman to till the ground. Idolators rage and domineer over Christians; and yet priests, who ought to lie weeping upon the pavement in sackcloth and ashes, covet names of vanity and glory in new and profane titles. But, far from Christians be this blasphemous name, by which all honour is taken from all other priests, while it is foolishly arrogated by one."

All the exertions of Gregory to oppose his rival proved unavailing, nor did he assume the appellation of universal bishop, which, after anathematizing it in his letter to the emperor, would have been a gross violation of decency. His successor, however, Boniface III. took this title, and the grant of it to Boniface's dignity by the tyrant Phocas, may be said to have established the power of the papal see; to maintain and enlarge which every method was tried by the succeeding pontiffs. It appears from authentic accounts of the transactions of the period to which we now refer, that the ambitious views of the bishops of Rome were strenuously opposed, not only by the emperors and princes, but by whole nations. Notwithstanding the threats and promises of the legates of Rome, the ancient Britons and Scots long persisted in the maintenance of their religious liberty. By the churches of Gaul and Spain no more authority was attributed to the bishops of Rome than was deemed consistent with their own interests and suitable to their dignity. In Italy itself the supreme authority of the bishop of Rome was boldly rejected, and there were not wanting individuals who openly expressed their abhorrence of the arrogance and the vices of the popes. In the same century, too, the Valdenses or Vaudois retired into the vallies of Piedmont, with the view of being more at liberty to withstand the tyranny of their oppressors. The papal power, however, continued rapidly to extend, though the ignorance and corruption of the clergy during the seventh and eighth centuries was deplorable, insomuch that few of the bishops could be found who were capable of composing the discourses, however mean and incoherent, which, as instructors and defenders of the Christian church, they were bound to deliver occasionally to the people. Among the higher ecclesiastics of those times, indeed, the want even of an acquaintance with the first rudiments of literature was so general, that to acknowledge it was scarcely deemed dishonourable; and many instances occur in the acts of the councils of Ephesus and Chalcedon of inscriptions in this form: "I, such an one, have subscribed, by the hand of such an one, because I cannot write." And such a bishop having said that he could not write, I, whose name is underwritten, have subscribed for him."* Those among the monastic orders who were absurdly dignified with the character of learning, generally devoted themselves to the study of fabulous legends of pretended saints and martyrs rather than to the cultivation of useful knowledge.

During three successive centuries there had been lavished on the clergy riches, immunities, and privileges, the consequence of which was a relaxation of discipline and the introduction of disorders calculated to destroy the spirit of the Christian profession; and the pure principles of Christianity were at length lost sight of in the grossness of superstition. From the circumstance of money affording a licence to commit civil crime, the notion was formed, in those dark times, that heaven might be conciliated by making benefactions to the church. The influx of wealth by this means to the clergy in the west was immense. To the barbarous nations who received the gospel, the Roman pontiff appeared as the successor of their chief druid or high priest. August privileges were thus bestowed upon him, to which he was careful to strengthen his title by every possible means. The extraordinary honours conferred upon him by a superstitious people, had the effect to communicate to the see of Rome an unprecedented power and authority; and hence arose the absurd opinion, that all such persons as were excluded from the communion of the church by the pontiff himself, or any of the bishops, forfeited thereby their civil rights and advantages as citizens, and even the common claims and privileges of humanity,—an opinion which, with all its bloody consequences, tended very effectually to augment and confirm the papal authority. Contemplating more than a mere spiritual delight in the dignity to which he was now elevated, the bishop of Rome arrogated to himself all the authority of a prince. He intrigued with the court of France, offering to withdraw his obedience from the emperor, and give the consulship of Rome to Charles Martel, the prime minister of that court, if he would take him under his protection; but he did not live to see his ambitious views realized.

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* In the *Marmion* of Sir Walter Scott, Douglas is made to say,

> "Thanks to Saint Bothan, son of mine,
> Save Gawain, ne'er could pen a line,
> So swore I, and I swear it still,
> Let my boy-bishop fret his fill!!"

The successor of Gregory III. was an individual of the name of Zachary. This artful politician succeeded in wresting from Luitbrand, king of the Lombards, an addition to the patrimony of the church. When Pepin, the son and successor of Charles Martel, assembled the states of the realm, with the view of deposing his sovereign, it was agreed that the Roman pontiff should be consulted respecting the legality of attempting the execution of such a project, and ambassadors were accordingly sent by him to Zachary, to inquire whether the divine law did not permit a valiant and warlike people to dethrone a pusillanimous and indolent monarch, who was incapable of discharging any of the functions of royalty, and to substitute in his place one more worthy to rule, and who had already rendered most important services to the state? Zachary consulted his own interest in granting a decision favourable to the usurper, and Pepin found little difficulty in stepping into the throne of Childeric III. This decision was confirmed by the successor of Zachary, Stephen II. who undertook a journey into France for the purpose of soliciting assistance against the Lombards, and who at the same time dissolved the obligation of the oath of fidelity and allegiance which Pepin had sworn to his master and sovereign, and violated by his usurpation of the throne, A. D. 751. Stephen, moreover, anointed and crowned him with his wife and two sons, and, by the authority of St Peter, forbade the French lords, on pain of excommunication, to make choice of a king of another race. The criminality of Stephen, in prosecuting his own ambitious schemes, by establishing Pepin on the throne of France, was not a little aggravated by the pretence of religion. "It is you," said he, addressing the audacious usurper, "whom God hath chosen from all eternity. For whom he did predestinate, them he also called; and whom he called, them he also justified."

A prodigious accession to the opulence and credit of the church was the consequence of this compliance of the bishops of Rome. Stephen II. was powerfully supported by the monarch of France. When the Lombards threatened to reduce all Italy under their yoke, Pepin crossed the Alps, A. D. 754, with a numerous army, and, after defeating Aistulphus, one of the kings of the Lombards, bound him by a solemn treaty to deliver up to the Roman see the exarchate of Ravenna, Pentapolis, and all the cities, castles, and territories which he had seized in the Roman dukedom. This treaty, however, was in the following year violated by the Lombard prince, but, through the urgent entreaties of Stephen, he again received assistance from the French monarch, in consequence of which Aistulphus was soon obliged to raise the siege of Rome and enter into a treaty, by which he confirmed the former terms with some farther sacrifices. On this occasion all the places thus yielded up by Aistulphus, including the exarchate taken by him from the emperor of Constantinople, were ceded for ever to the holy see by king Pepin, who, moreover, caused the instrument of donation which he had signed, and the keys of all the cities, be laid on the tomb of St Peter in Rome. In this manner did Stephen become proprietor of the exarchate and its dependencies, and attain to the power of a temporal prince.

During the reign of the emperor Constantine Copronymus, a synod was held at Constantinople to decide the question concerning images, which had long agitated both the eastern and western churches. In this council it was decreed, that all sorts of images formed by the artist should be cast out of the Christian church. Paul I. who was then pope of Rome, was unsuccessful in opposing this measure. His successor, who was a person of the name of Constantine, after having filled the papal chair for one year, was deposed for condemning the worship of images; and Stephen IV., on being substituted in the room of Constantine, shewed himself a most furious defender of the worship of images.

Pepin, king of France, died in the year 768. His son and successor Charlemagne, who in private life is said to have been exemplary for every virtue, unfortunately entertained an enthusiastic attachment to the Roman see, which mingled itself with all his policy, and led him, in his zeal for the propagation of Christianity, to commit the most shocking severities.

A new attack was at this period made upon the patrimony of St Peter, by Desiderius king of the Lombards. But Charlemagne marched with a large army to the succour of Adrian, the successor of Stephen in the papal chair, and recovered the cities taken by Desiderius, after which he visited Rome, and formed a perpetual league of friendship between the growing power of France and the established supremacy of the Western church. During this visit Pavia, had been left in a state of siege. On his return, however, it surrendered; and the dynasty of the Lombard princes, which had lasted 206 years, was brought to a close, A. D. 776. It seems more than probable that Charlemagne, while he consulted the favour of the Roman pontiffs and clergy, was only waiting a favourable occasion for assuming the supreme dominion over the city of Rome and its teritory, upon which the Western empire appeared then to depend. In the year 796, Pope Leo III. the successor of Adrian, transmitted to him the Roman standard, with a request that he should send some person to receive the oath of fidelity from the Romans. Highly gratified by this instance of submission, he visited Rome, A. D. 800; and on Christmas day, as he assisted at mass in St Peter's, an imperial crown was, by the pope, put upon his head, after which he was conducted to a magnificent throne, and there received those honours which, by his predecessors, had been usually paid to the Roman emperors. The king was then invested with the imperial mantle, after which he returned to his palace, amid the joyous acclamations of the people. For these distinguished favours, Charlemagne shewed himself by no means ungrateful. The patrimony of the church consisting of farms and houses, had been, by the bounty of the French kings, converted into the temporal dominion of provinces; and the cities and lands which had formerly been annexed to the exarchate of Ravenna, were now given to the pope as an enlargement of the circle of the ecclesiastical state. Thus the world beheld a Christian bishop invested with the prerogatives of a temporal prince, the choice of magistrates and the exercise of justice, the imposition of taxes, and the wealth of the palace of Ravenna. But notwithstanding such grants of temporal power, the supreme dominion over the church and its possessions was, both with the eastern and western world, vested in the emperors and kings. The sovereignty of the Grecian emperors, in this respect, was never disputed; and the wisest and most candid writers, even of the Romish communion, have acknowledged the supremacy of the Latin monarchs over the church. The right of election to the see of Rome was, by Adrian I. conferred upon Charlemagne and his successors; and though neither he nor his son Louis seemed disposed to exercise this prerogative in all its extent, the right was reserved of approving and confirming the person who should be elected to that dignity by the priests and people, so that the consecration of the elected pontiff, if not performed in presence of the emperor's ambassadors, was of no validity whatever. The power of convening councils, and the right of presiding in them were the prerogatives of the emperors and sovereign princes in whose dominions they were held; and no decrees of any council obtained the force of laws until the supreme magistrate approved and confirmed them. The spiritual authority of Rome was thus wisely bounded by the civil power; a circumstance which was extremely galling to its arrogant and ambitious pontiffs, who strenuously laboured to maintain a supreme dominion over the church, and even sovereigns themselves.

In the following century, wars and tumults arose, which contributed not a little to promote the aspiring views of the Roman pontiffs. But before narrating those events which, during the ninth and succeeding centuries, raised the papal see to its greatest height of authority, it may be proper to observe, that although hitherto the emperor's approbation was indispensable, in order to the consecration of the person chosen to the pontificate, a new scene of things arose after the time of Charles the Bald. As a mark of gratitude to the bishop of Rome, through whose good offices he obtained the imperial dignity, that prince delivered the succeeding pontiffs from the obligation of waiting for the consent of the emperors before they could be installed in their office. Owing to this signal service, the election of the pontiff was carried on without any regard to law, order, or decency, from the time of Eugenius III. who was elevated to the pontificate A. D. 884, until the reign of Otho the Great. Of the prelates that were raised to the pontificate in the ninth century, there were few who were remarkable for any thing but their flagitious actions. Between the pontificate of Leo IV. who died in the year 855, and that of Benedict III. a certain woman, by disguising her sex very artfully, and attaining a character for learning and genius, is said to have had the dexterity to gain the papal chair, and to have held it for two years under the title of Pope Joan.

In consequence of a fierce and dreadful contest having broken out between the posterity of Charlemagne, among whom were several competitors for the imperial dignity, the Italian princes and Pope John VIII. seized with avidity the opportunity of assuming the right of nominating to the throne, and of excluding the nations who had formerly the right of suffrage from all concern in the election. By means of rich presents and flattering promises, Charles the Bald conciliated their favour, and was accordingly proclaimed, in the year 876, King of Italy and emperor of the Romans. Carloman and Charles the Gross, who succeeded him in the kingdom of Italy, were also elected by the Pope and the Italian princes. After the reigns of those potentates the empire was torn in pieces, and serious commotions arose in Italy, France, and Germany, which were ruled by various chiefs; and in this confused scene the highest bidder was commonly raised to the sovereignty of Italy, and to the imperial throne, through the instrumentality of the popes, who, in all their proceedings, were actuated by the most selfish motives.

About the middle of the ninth century, the papal chair was filled by Nicholas I. a prelate who was accused of the most presumptuous arrogance, even by his own clergy, the bishop of Treves and Cologne. This individual asserted his dominion over the French clergy, and received appeals from all ecclesiastics dissatisfied with their bishops, and thus taught the people to acknowledge a supreme tribunal at a distance from their own country. Deplorable as the state of things now was, it is gratifying to find that the presumptuous behaviour of the pontiffs did not always go without remonstrance. Thus the haughty pretensions of Adrian II. the successor of Nicholas, provoked Hincmar, archbishop of Rheims to such a degree, that he boldly desired the pope to call to mind that respect and submission which had always been paid to princes by the ancient pontiffs, and to reflect that he possessed, by his office, no legitimate right to interfere with the government of kingdoms; that he could not be, at the same time, pontiff and king; that the choice of a sovereign belongs to the people; that anathemas misapplied are ineffectual; and that freemen are not to be enslaved by a bishop of Rome. In defiance, however, of the spirited expostulation of Hincmar, the evil proceeded. A council was, by Pope John VIII. convened at Troyes in France, one of the canons of which is not a little characteristic of the spirit of the times, from its asserting that *the powers of the world shall not dare to seat themselves in the presence of the bishops unless desired.* Indeed the period was now arrived, in which the clergy aspired to the right of disposing of crowns,—a right which they founded on the ancient Jewish practice of anointing kings. Elate with their overgrown prosperity and the daily accessions made to their power and authority, they laboured, not without success, to persuade the people that the bishop of Rome was, by Jesus Christ, constituted supreme legislator and judge of the church universal, and that, consequently, the bishops derived all their importance from the pope, nor could any thing be determined by the councils without the acquiescence of his holiness.

It is unanimously confessed by all writers, that the history of the popes who lived in the tenth century presents a tissue of the most audacious crimes, which originated chiefly in the calamities which fell upon a great part of Europe, and which in a particular manner afflicted Italy after the extinction of the race of Charlemagne.

After the death of Benedict IV. A. D. 903, Leo V. was elevated to the pontificate, but was in a very short time deprived of his dignity by Christopher, who, in his turn, was dethroned by Sergius III. a Roman presbyter, seconded by Adalbert, a powerful Tuscan prince, who maintained great influence in Rome. Anastasius III. and Lando were next raised successively to the papal dignity, but did not long enjoy it. Upon the death of the latter, A. D. 914, John X. who was a person of a base character, succeeded to the office of pontiff, and to him Rome and Italy were indebted for deliverance from the Saracen power, which had been the terror of all Italy for the space of 40 years. This prelate soon shewed in how little reverence he held the canons of the church, by confirming in the archbishopric of Rheims the nomination of Hugh, a child only five years of age, and son of Count Herbert. It was through the intrigues of an abandoned female, of the name of Theodora, that John obtained the pontifical chair, and he lost his dignity and life through the machinations of Marozia, the daughter of the same prostitute. After this pontiff Leo VI. obtained the apostolical chair, which he held only for seven months, and was succeeded by Stephen VII. On the death of Stephen, A. D. 931, the papal dignity devolved upon John XI. who was the first fruit of Marozia's infamous amours with Sergius III. But he was dethroned two years after, by his half-brother, Alberic. Hugh, king of Lombardy was, through the influence of Marozia, whom he married next, placed at the head of the church; but he soon rendered himself hateful to the Romans, and excited the resentment of Alberic, who, at the head of the discontented, attacked the castle of St Angelo, and became master of the fortress. The four pontiffs, who in their turns, succeeded John XI. and occupied the papal chair till the year 956, were Leo VII. Stephen VIII. Marinus II. and Agapet. After the death of the latter, the pontificate was conferred upon Alberic II. who raised his son Octavian,—a youth inexperienced, and destitute of every requisite quality,—to the dignified station of head of the church. By assuming the name of John XII. this unworthy pontiff introduced the custom that has been since adopted by all his successors in the Roman see, of taking another name upon the acquisition of the pontificate. The elevation of John had been viewed as a scandalous procedure; and by his follies and debaucheries he forfeited his office, and at length met an untimely death. The Romans now appointed Benedict V. bishop of Rome, in opposition to Leo VIII. who had been previously raised to the papal chair by Otho the Great; but the latter was soon restored by the interference of the emperor, and Benedict was banished to Hamburgh. Leo died in the year 965, and John XIII. succeeded him in office, through the favour of the emperor, who supported him, notwithstanding the determined opposition of the Roman people. This pontiff, according to some writers, was the first person who introduced the practice of blessing or consecrating church bells. During his reign, the Poles, it is said, were first converted to Christianity. Benedict VI. next obtained the papal chair, but, unfortunately for him, the emperor died in the year 973, and with him expired that order and discipline that had been restored in Rome by salutary laws. Crescentius, the son of the famous Theodora, threw this pontiff into prison, where he was treated in the most ignominious manner, and at length strangled in the year 974. Upon the death of Benedict, the pontificate was given to Franco, who took the name of Boniface VII. but was soon pulled down from the summit of spiritual grandeur, and expelled the city. Donus II. was then promoted to the papal chair; and after his death Benedict VII. succeeded to it, and ruled the church, with little opposition, for nine years. Pope John XIV. was raised by Otho III. from the bishopric of Pavia to the pontificate. But losing afterwards the good will of the emperor, he was surrounded with many calamities, and his transitory grandeur terminated in misery. Boniface VII. who had usurped the papal throne, A. D. 974, and had been shortly after banished from Rome, returned from Constantinople, where he had taken refuge, and effected the destruction of the unfortunate pontiff. About six months after his restoral, Boniface died, and was succeeded by John XV. who, in the year 993, at a council held at the Lateran palace, after having read an account of the life and supposed miracles of Ulderic bishop of Augusta, declared, with the approbation of his bishops, that from thenceforth Ulderic might be worshipped and invoked as a saint in heaven reigning with Christ. Of the solemn canonization of a pretendedly meritorious character, this is the first instance on record; but this practice soon contributed to crowd the Roman calendar with saints; and the church was loaded with wealth by the rich offerings with which the superstitious multitude was encouraged to propitiate those mediators between God and man. John XV. had the advantage of being a Roman by birth, and a descendent from noble and illustrious ancestors, and his administration was as happy as the troubled state of the Roman affairs would permit. His successor, Gregory V., who was elected by the order of Otho III. in the year 996, did not long enjoy the pontificate; he was deprived of his dignity by Crescens the Roman consul, and John XVI., formerly known by the name of Philagathus, was appointed in his stead. But John was not permitted long to reign in peace. By several councils held in Italy, France, and Germany, he was excommunicated, and he at length fell into the hands of some of the friends of Gregory, by whom he was treated in a most barbarous manner, for, not satisfied with depriving him of his sight, and cutting off his nose, they glutted their revenge by leading him upon an ass through the street, and compelling him to exclaim, as he was borne along, "Whoever shall dare to dispossess a pope, let him be served like me." Gregory V. died shortly after his restoration, and Gerbert, or Sylvester II. was, on account of his learning and talents, raised, without opposition, to the papal dignity.

The ignorance and superstition which, in these unhappy times, reigned without control, had the effect gradually and imperceptibly to increase the power and authority of those who gave themselves out as Christ's vicegerents upon earth, while the ambitious attempts of the pontiffs were seconded by the adulation of certain mercenary prelates, who exalted, in the most pompous terms, the dignity and prerogatives of what they were pleased to denominate the apostolical see. Certain bishops also were servile enough to maintain publicly that the popes were bishops, not only of Rome, but of the whole world; and, according to some learned writers, there were some among the French clergy who asserted that the authority of the Roman pontiffs, though in its origin divine, was conveyed to them by the apostle Peter.

After the death of Sylvester II. in 1003, the see of Rome was filled successively by John XVII. John XVIII. and Sergius IV., who were confirmed in their dignity by the approbation and authority of the emperors under whose reign they were elected. During the pontificate of Benedict VIII., who was elected A.D. 1012, and continued in office twelve years, the Normans invaded Italy, and reduced, under their own dominion, several of its richest provinces. John XIX., the brother of Benedict, afterwards succeeded to the papal throne, which he held till the year 1033. The five pontiffs just mentioned are said to have conducted themselves in a manner suitable to their station, but many of their successors became infamous by the most gross licentiousness and immorality. Benedict IX. was a person of the most abandoned habits, who, after being twice degraded from his high office, sold the pontificate to John Gratian, arch-presbyter of Rome, who took the title of Gregory VI. Between Gregory and John, bishop of Sabina, who had been elected in the year 1044, when Benedict was first deposed, and had assumed the name of Sylvester III., a contest now arose for the superiority, which, after much disturbance, was brought to a conclusion in the council held at Sutri A.D. 1046, when Benedict, Gregory, and Sylvester were declared unworthy of the papal dignity. Suidger, bishop of Bamberg, was immediately placed at the head of the church, under the title of Clement II., but he only lived to enjoy his office a few months. Upon the death of Clement, Benedict IX., notwithstanding the degradation he had already experienced, aimed anew at the dignity of pontiff, which he had the address to obtain a third time. In the following year, however, he was compelled to surrender the government of the church to Poppo, bishop of Brixen, who was elected in Germany under the title of Damasus II., and sent into Italy to take that dignity. Damasus died shortly after, and was succeeded by Bruno, bishop of Toul, known by the name of Leo IX. In the year 1053 this prelate entered into an unsuccessful war with the Normans, whom he was grieved to see in the possession of Apulia, and was taken prisoner by the enemy, and carried to Benevento, where he was imprisoned one year. Upon the death of Leo, A.D. 1054, the pontificate was given to Gebhard, bishop of Eichstadt, who assumed the name of Victor II. After a reign of three years, this prelate was succeeded by Stephen IX., brother to Godfrey, duke of Lorrain. Under the administration of these popes nothing occurred of any consequence. The successor of Stephen was Nicholas II., a prelate who distinguished himself by his public acts of zeal and piety. With the view of preventing the tumults and commotions which arose in Rome, and the factions which divided Italy when a new pontiff was to be elected, Nicholas assembled a council at Rome in the year 1059, in which a decree was passed for changing the ancient form of election. Nicholas received the homage of the Normans, and solemnly created Robert Guiscard Duke of Apulia, Calabria, and Sicily, on condition that as a faithful vassal, he should observe an inviolable allegiance to the church, and pay an annual tribute in acknowledgment of his subjection to the see of Rome; a grant which laid the foundation of the kingdom of Naples, or of the two Sicilies, and of the sovereignty over that kingdom which is annually acknowledged by the Sicilian monarchs. Over the mind of Nicholas, Hildebrand enjoyed a supreme ascendancy. Having himself an eye to the pontificate, this individual, who was originally a monk of the order of Cluny, found means to realise his ambitious views. He obtained the papacy in the year 1073, and assumed the title of Gregory VII. Of this extraordinary character, it is remarked by Voltaire, that whatever the malice or flattery of a multitude of writers have said of him, "is concentrated in a portrait of him, drawn by a Neapolitan artist, in which Gregory is represented as holding a crook in one hand and a ship in the other, trampling sceptres under his feet, with St Peter's net, and fishers on either side of him." Gregory began his reign with excommunicating every ecclesiastic who should receive a benefice from a layman, and every layman by whom such benefice should be conferred, a measure by which he at once engaged the church in an open war with all the sovereigns of Europe. Gregory seems, not without success, to have formed the romantic project of making himself lord of Christendom, and at once dissolving the jurisdiction which kings and emperors had hitherto exercised over the various orders of the clergy, and subjecting to the papal authority all temporal princes, rendering their dominions tributary to the see of Rome. When the king of Hungary was dethroned by his cousin Geysa, Gregory favoured the usurper, and exclaimed against the unhappy monarch, on account of his having renewed his homage to him as head of the empire. "You ought," said he, "to know that the kingdom of Hungary belongs to the Roman church; and learn that you will incur the indignation of the holy see if you do not acknowledge that you hold your domains of the pope, and not of the emperor." The despotic views of this ecclesiastic were attended with such success, that, from the time of his pontificate, the prerogatives of the emperors and other sovereign princes were considerably diminished. He was the first pontiff who presumed to deprive a sovereign of his crown; and his severe treatment of Henry was certainly more becoming a tyrant than an apostolical father. The right of nominating bishops and abbots, and of giving them investiture by the ring and crozier had hitherto been the prerogative of the princes of Christendom, to whom legates were usually sent by the pontiffs to entreat their assistance to obtain their confirmation, or to request them to come and receive papal sanction. But Gregory now claimed this right, and sent legates to Henry, commanding him to yield obedience to the church, and not to interfere with investitures. As Henry treated this message with merited contempt, vengeance was denounced against him by the pope, in a council convoked for the express purpose, at which were present one hundred and ten bishops. "In the name of Almighty God, and by your authority," said this ghostly ruler, addressing the members of the council, "I prohibit Henry from governing the Teutonic kingdom and Italy. I release all Christians from their oath of allegiance to him; and strictly forbid all persons to serve or attend him as king." In consequence of this execrable sentence pronounced against the emperor and his adherents, the bishops immediately came over to the party of Gregory, and drew with them many of the nobles; the Saxons took the opportunity of revolting; and even Henry's favourite, Guelph, a nobleman to whom he had given the duchy of Bavaria, supported the malecontents. The unhappy monarch, to avoid the odium of an impending trial at Augsburg, submitted to the degradation of preparing to throw himself at the feet of the pope, and to entreat for absolution. Accordingly, he, with his wife and infant son, set out for Italy, where, on his arrival, he was favourably received by the counts and bishops of Lombardy, who offered to assist him with men and money to enable him to revenge the treatment he had received from the Roman pontiff. Gregory had in the meantime proceeded as far as Lombardy; and when he was informed of the reception the king had met with, he returned to the stronghold of Canosa, in the diocese of Reggio. Some time elapsed before the order was issued to admit Henry into the presence of the pope. The order was, that he should enter at the outer gate of the fortress without attendants; and that he should, at the next gate, divest himself of the ensigns of royalty, and put on a coarse woollen tunic. In this dress, and barefooted, he was suffered to stand for three whole days at the third gate, exposed to the inclemency of the season, fasting, and imploring the mercy of God and the pope, till at length he was, on the fourth day, admitted to Gregory, who, after much entreaty, condescended to grant him absolution. The detestable arrogance of the pope in this affair, and the abject humility of the king, gave great offence to the Italian princes; the consequence of which was, that all Lombardy took up arms against the pope. Gregory now had recourse to every art to procure the election of another emperor in Germany; while Henry left nothing undone on his part to persuade the people to make choice of another pontiff. Rodolph, duke of Suabia, was appointed to the throne by the Germans, and solemnly crowned at Mentz. The circumstance of Rodolph having been consecrated without the pope's order, afforded Gregory an opportunity of exercising all his finesse for the purpose of extorting submission from Henry; and he declared, that he would acknowledge as emperor and king of Germany that claimant only who should be completely submissive to the holy see. Henry having little faith in the generosity of the pope, now marched his troops against Rodolph, whom he defeated in several engagements. Enraged by this conduct on the part of Henry, the pope now fulminated his anathemas against him, desiring the world at the same time to take notice, that it is in the power of the Roman pontiff to take away empires, kingdoms, and principalities, and to bestow them on whom he pleases. Henry afterwards summoned a council of German bishops to meet at Mentz, who adjourned their sessions to Brixen, where they were joined by many of the Italian bishops, and German and Italian princes. Gregory was in this council accused of oversetting the hierarchy, and assuming the dignity of sole monarch of the church, encouraging sedition and rebellion, persecuting, excommunicating, and deposing a peaceable king, and placing a rebel on the throne. It was therefore resolved that he should be deposed, and that another should be chosen in his place. After the election of Clement III. the affairs of Henry quickly revived. When he went to Italy to settle the new pontiff in the papal chair, he found the gates of Rome shut against him; but he attacked the city in form, and took it after a siege of two years. The siege of the castle of St Angelo, to which Gregory had retired, was then prosecuted with vigour; but, in the absence of Henry, the pope effected his escape. He died at Palermo, in the year 1085. Of this ambitious pontiff, it may be remarked, that had his success been equal to the extent of his views, all the kingdoms of Europe would perhaps have been brought under subjection to the Roman see; but though his most important projects were ineffectual, many of his attempts were crowned with a favourable issue. "He was," to use the words of the celebrated Mosheim, "a man of uncommon genius, whose ambition in forming the most arduous projects was equalled by his dexterity in bringing them into execution; sagacious, crafty, and intrepid, nothing could escape his penetration, defeat his stratagems, or daunt his courage; haughty and ardent beyond all measure; obstinate, impetuous, and untractable, he looked up to the summit of universal empire with a wistful eye, and laboured up the steep ascent with uninterrupted ardour and invincible perseverance; void of all principle, and destitute of every pious and virtuous feeling, he suffered little restraint in his audacious pursuits from the dictates of religion or the remonstrances of conscience."

The tumults and divisions which Gregory had excited, continued after his death to oppress the state. Urban II., in conjunction with the countess Matilda, used every possible means to seduce Conrad, the son of Henry IV. into a rebellion against his father. In his usurpation this prince succeeded so well under the title of king of Italy, that many of the cities of Italy, and their nobles, acknowledged him as their sovereign. As the emperor despaired of being able to reduce him to obedience by arms, he assembled the princes of Germany, who unanimously declared for his brother Henry. Both Conrad and the pope died shortly after, when the former was succeeded by his younger brother Henry as prince of Italy, and the latter was succeeded in the papal chair by Paschal II. The new pope, who was in his general character another Gregory, was no sooner invested in office than he began to corrupt the mind of young Henry, by exciting him to rebel against his father. His base attempts were too successful. A rebellion ensued, the consequences of which, however, were not so favourable to Paschal as had been expected; for he had the mortification to find that the new emperor was resolved, equally with his predecessors, to maintain his right to investitures. In a council held at Troyes, A.D. 1107, the bishops assembled from many places confirmed all the decrees respecting the pretended right of the Pope to investitures. A compromise was, in the following year, effected by Henry; but no sooner had the treaty been concluded than Rome was filled with tumults and sanguinary wars. A vehement clamour was now raised against Paschal for his having scandalously violated the duties and dignity of his office, and prostituted the majesty of the church, by his complying with the emperor's demands. Paschal, with the view of appeasing these commotions, assembled a council in the Lateran church, where he humbly acknowledged his culpability in concluding such a treaty with Henry, and at the same time submitted the question to the determination of the council, who accordingly took that treaty into consideration, annulled it in a solemn manner, and sanctioned the excommunication of the emperor. Between the parties hostilities were carried on with great violence till the year 1118, when Paschal died, after a troublesome reign of about eighteen years.

John of Gaieta, a Benedictine monk of Mont Cassin, and chancellor of the Roman church, succeeded Paschal with the title of Gelasius II., but in consequence of the election, by Henry, of Maurice Burdin, archbishop of Braga in Spain, under the title of Gregory VIII., he removed to France, and died shortly after at Clugni. Immediately after the death of Gelasius, the cardinals who had accompanied him in his journey appointed to the papal chair Guy, archbishop of Vienne, count of Burgundy, who assumed the appellation of Calixtus II. This pontiff was nearly related to the emperor, whom he opposed with courage and success. He was distinguished not so much for his illustrious birth as for his noble and heroic qualities. He made himself master of Rome, imprisoned the pontiff that had been chosen by the emperor, and fomented the civil commotions in Germany. In a word, the elevation of this eminent ecclesiastic was attended with the best consequences, for his principal aim was to restore public tranquillity. Shortly after the death of Calixtus, in the year 1124, Lambert, bishop of Ostia, was raised to the pontificate under the title of Honorius II., but nothing worthy of notice was transacted by him. Upon his death, in 1130, a considerable dispute arose in the church of Rome, or rather in the college of cardinals, of whom one party elected to the papacy Gregory, a cardinal deacon of St Angelo, who took the name of Innocent II., while the other chose for successor to Honorius, Peter the son of Leo, who assumed the title of Anacletus II. By the death of Anacletus, A. D. 1138, the apostolical chair was left to Innocent II., who in the following year presided at the second Lateran council, and died in peace about four years after. Guy, cardinal of St Mark, next obtained the papacy, and enjoyed a tranquil reign of only six months, under the title of Celestine II. The pontificate of his successor Lucius II. was disturbed by various tumults and seditions, and was of short duration; he lost his life while endeavouring to quel a riot by his presence and authority. Lucius was succeeded in the year 1145 by a worthy ecclesiastic, Bernard, a Cistertian monk, distinguished in the list of the popes by the title of Eugenius III. His reign, which lasted eight years, was embittered with perils and perplexities, insomuch that he was frequently obliged to leave Rome and save his life by flight. Upon the death of Eugenius, the papal chair was filled by Conrad, bishop of Sabino, under the title of Anastasius IV.; but he died about sixteen months after his elevation to the see of Rome. Under the pontificate of Adrian IV., who was a native of England, and whose original name was Nicholas Breakspear, the contest between the emperors and the popes, which was considered as at an end since the time of Calixtus II., was unhappily renewed. Frederic I. surnamed Barbarossa, being placed on the imperial throne, A. D. 1152, declared openly his determination to maintain the dignity and privileges of the Roman empire in general, and more particularly to render it respectable in Italy; nor was he at all studious to conceal the design he had formed of reducing the overgrown power and opulence of the popes and clergy within narrow limits. Adrian, therefore, prepared to defend vigorously the majesty of the church and the authority of the clergy; but his death, which happened A. D. 1159, prevented the rupture that was expected to take place between the emperor and the pontiff.

A schism now took place among the cardinals respecting the election of a new pontiff. By one party Roland, bishop of Sienna, who assumed the title of Alexander III., was elevated to the papal chair; while, by another, Octavian, cardinal of St Cecilia, known by the name of Victor IV., was appointed to the same dignity. The latter died in the year 1164, and Guy, cardinal of St Calixtus, was by the emperor appointed to succeed him with the title of Paschal III. In consequence of this election, Alexander proceeded to maintain his own rights to the papacy with great resolution and vigour. In the year 1167 he held the Lateran council at Rome, and there solemnly deposed the emperor whom he had formerly, upon several occasions, loaded with anathemas and execrations, dissolved the oath of allegiance which his subjects had taken to him as their lawful sovereign, and encouraged and exhorted them to rebel against his authority, and to throw off his yoke. Frederic immediately resolved to punish the insolent pontiff for his audacity; but, after a warm contest, which lasted during the space of three years, he was at length obliged to conclude a peace with Alexander, and a truce with the rest of his enemies. After the death of Alexander, Ubald, bishop of Ostia, took the appellation of Lucius III. and was, by the suffrages of the cardinals alone, raised to the pontificate in the year 1181. This pontiff was involved in the same difficulties and perplexities that had embittered the government of his predecessors. He was twice driven out of the city by the Romans, who could not endure a pope that was elected in opposition to the ancient custom, without the knowledge and consent of the clergy and the people. In the midst of these troubles he died at Verona, A. D. 1185, and was succeeded by Hubert Crivelli, bishop of Milan, who assumed the title of Urban III., and who, without having transacted any thing remarkable, died in the year 1187, upon hearing that Saladin had made himself master of Jerusalem. His successor, Albert, whose papal denomination was Gregory VIII., only lived to enjoy his dignity two months. Paul, bishop of Preneste, obtained the pontificate with the title of Clement III. and distinguished himself only by the publication of new crusades. Celestine III. forms a conspicuous character in history. This pontiff thundered his excommunications against the emperor Henry VI. and Leopold, duke of Austria, on account of their having seized and imprisoned Richard I. of England, as he was returning from the Holy Land. He also anathematised Alphonso X. king of Gallicia and Leon, on account of an incestuous marriage into which that prince had entered, and enjoined Philip Augustus, king of France, to readmit Ingelburga, his queen, whom he had divorced, to the conjugal state and honours.

Lotharius, count of Segni, cardinal deacon, otherwise known by the name of Innocent III. was placed at the head of the church in the year 1198. Following the steps of Gregory VII. this illustrious pontiff not only usurped the despotic government of the church, but also claimed the empire of the world, and thought of nothing less than subjecting kings and princes to his lordly sceptre. With the most wanton ambition, he disposed of crowns and sceptres in Asia and Europe. So unbridled was his ambition, that he resolved to render the power and majesty of the Roman see formidable to the greatest European monarchs, and even to the emperors themselves. He exercised a despotic command over the emperors and kings, whom he raised and deposed; over the nations, whom an interdict of months or years deprived, for the offence of their rulers, of the exercise of Christian worship. In the council of the Lateran, he acted as the ecclesiastical, almost as the temporal sovereign, of the east and west. It was his to boast of the two most signal triumphs over sense and humanity, the establishment of transubstantiation and the origin of the inquisition. Innocent undertook a journey to Pisa in the year 1216; but on his arrival at Perugia he was attacked with a violent disorder, which in a few days put a period to his existence.

This extraordinary pontiff was succeeded by Censio Savilli, who, assuming the title of Honorious III. ruled the church about ten years, and distinguished himself chiefly by an ardent zeal for maintaining the pretensions and supporting the despotism of the Roman see. He was succeeded in the pontifical chair by Hugolin, bishop of Ostia, who assumed the title of Gregory IX. and kindled into open violence the feuds and dissentions that had already secretly subsisted between the church and the empire. By the immoderate ambition, injustice, arrogance, and obstinacy of this aged pontiff, Italy was involved in many calamities. The successor of Gregory IX. was Geoffrey, bishop of Milan, after whose death the apostolical chair was filled by Sinibald, one of the counts of Fieschi, under the title of Innocent IV. This pontiff yielded to none of his predecessors in arrogance and fury. No sooner did Frederic II. receive the news of his elevation, than he sent a splendid embassy to congratulate him upon his election, and to assure him that nothing should be wanting to re-establish harmony between the church and the empire. But as the pope determined to maintain the highest pretensions of the apostolical see, he disregarded the terms of friendship offered by Frederic, whom he afterwards excommunicated, but whose eldest son, Conrad, opposed Innocent with such zeal and intrepidity as rendered him fully sensible of his inability to withstand that prince. Worn out with fatigue and disappointment, Innocent died in the year 1254, after a reign of about twelve years. He was succeeded by Reynald, count of Segni and bishop of Ostia, known in the list of the popes by the appellation of Alexander IV. The successor of Alexander was Urban IV. a native of Troyes, of obscure birth, who, before his elevation to the papal chair, was patriarch of Jerusalem, and after that period was more distinguished by his instituting the festival of the body of Christ than by any circumstance in the course of his reign. In the year 1265, Guy Fulodi, a native of France, and bishop of Sabino, obtained the pontificate, with the title of Clement IV. After his death, which happened in 1268, the Roman see was vacant for about three years, owing to the intrigues of the cardinals assembled at Viterbo, who all aspired to the dignity themselves, and opposed the election of any other; but being at length closely confined by the magistrates, in the bishop's palace, they ultimately made choice of Theobald, who was then with the crusaders in the east. Immediately after his consecration, Theobald, who had been an eye-witness of the miserable condition of the Christians in Palestine, summoned a council at Lyons for the purpose of effecting the reunion of the Greek and Latin churches, and concerting measures for their relief, on which occasion the famous law was enacted, which is still in force, that, during the vacancy of the pontificate, the cardinal electors should be shut up in the conclave. Theobald held the Roman see about four years under the title of Gregory X. Upon the death of this pontiff, Peter of Tarentaise, of the Dominican order, and bishop of Ostia, was raised to the pontificate, and assumed the name of Innocent V. He died, however a few months after his election, and in his place was chosen Ottoboni, a native of Genoa, and cardinal of St Adrian. He took the title of Adrian V. but his reign was of very short duration. Peter Julian, bishop of Tusculum, who succeeded him in 1276, and assumed the title of John XXI. ruled the church for the short period of eight months. For about six months after his death, the Roman see remained vacant. In the year 1277, John Caietan, of the family of Ursini, cardinal of St Nicholas, whose name he adopted for his papal title, was placed at the head of the church. The opulence and authority of the bishops of Rome were greatly augmented by this pontiff, but he did not live long to enjoy his high dignity. His successor was an audacious priest of the name of Simon Brie, who was remarkable chiefly for his ambitious schemes, during the execution of which he died in 1281. His papal title was Martin IV. James Saville, who assumed the name of Honorius IV., was not inferior to his predecessor in ambition and arrogance, but who ruled the church only two years. He was succeeded by Jerome D'Ascoli, bishop of Palestrina, in the year 1288. This pontiff took the name of Nicholas IV. and distinguished himself during his reign, which lasted four years, by his assiduous application both to ecclesiastical and political affairs. His death, which happened in 1292, is supposed to have been hastened by the disappointment he felt at the complete failure of his attempts for the relief of the Christians in the east, who were reduced to the greatest extremities of weakness and misery. Upon the death of Nicholas IV., great disputes arose among the cardinals about the election of a new pontiff, which occasioned a vacancy of two years in the see of Rome, after which the contending parties united their suffrages in favour of Peter, surnamed De Murrone, from a mountain where he had hitherto lived in the deepest solitude, and who was remarkable for the sanctity of his life and conversation, and the austerity of his manners. It was with reluctance that this venerable old man accepted of the pontificate, and, finding himself by no means agreeable to a degenerate and licentious clergy, he shortly after resigned his dignity. Peter, who had assumed the name of Celestine V., died in confinement in the castle of Fumone, A. D. 1296. The branch of the Benedictine order called Celestines derived their origin from him.

The papacy, which, it may be admitted, had ruled the civilized world for nearly 400 years, began gradually to decline at the close of the 13th century. Benedict Caietan, a base cardinal, at whose suggestion Celestine V. abdicated the papacy, was raised to the see of Rome by the title of Boniface VIII. in 1294, and was in the following year enthroned at Rome with great solemnity and parade. A quarrel arose between the French king, Philip, and this haughty ecclesiastic, from which may be dated the commencement of the decline of the papacy. Though many crowned heads had, without success, attempted to set bounds to the overgrown arrogance of the bishop of Rome, Philip the Fair, who was a bold and enterprising prince, soon convinced Europe of the possibility of effecting such a purpose, by treating with merited contempt Boniface and his presumptuous letters, wherein it was maintained that the king of France, and all other kings and princes, were obliged, by a divine command, to submit to the authority of the popes, as well in all political and civil matters as in those of a religious nature. In consequence of the famous bull which this lordly pontiff issued, asserting that Jesus Christ had granted a two-fold power to the church, or, in other words, the spiritual and temporal sword; that he had subjected the whole human race to the authority of the Roman pontiff; and that all who dared to dispute it were to be deemed heretics, and excluded from all possibility of salvation,—Philip, in an assembly of the peers of his kingdom, held A. D. 1303, commanded William De Nogaret, a celebrated lawyer, to draw up an accusation against the pope, charging him openly with heresy, simony, and other vices and crimes; and also urging the convocation of an œcumenical council for the speedy deposition of a pontiff so unworthy of his office. The pope, on the other hand, passed, in the same year, a sentence of excommunication against Philip and all his adherents; which circumstance exasperated the king so much, that he sent Nogaret and Sciarra Colonna into Italy to excite the persecuted Ghibellines against the pope; who accordingly approached the pope's palace in Anagni, where Boniface then resided, and made themselves masters both of his person and treasures. After a short confinement, during which he was treated with great indignity, the pope was rescued by the people of Anagni; but the mortification he felt, and the insults to which he had been exposed, hastened his death. It was this pontiff that, in the year 1300, instituted the famous jubilee, which since that time has been regularly celebrated at fixed periods in the church of Rome.

Boniface VIII. was succeeded in the papacy by Nicolas Boccacina, who took the name of Benedict XI. and governed the church, during his short reign, with prudence and moderation. Upon his death, which took place A.D. 1304, Philip succeeded, by his influence over the conclave, in obtaining the Roman see for Bertrand De Got, archbishop of Bourdeaux, who assumed the title of Clement V. and at the king's request remained in France, and removed the papal residence to Avignon, where it continued during the space of 70 years,—a period called, in derision, by the Italians, the Babylonish captivity.

The authority of the Roman see was no doubt very much impaired by the continued residence of the popes in France; during which period the faction of their inveterate enemies, the Ghibellines, rose to a great height, and had the effect to cause many cities to revolt from the popes. Rome itself, indeed, was the grand source and fomenter of cabals, tumults, and civil wars, insomuch that the laws and decrees sent thither from France were treated with contempt by the populace as well as by the nobles. From Italy the influence of this example soon spread through most parts of Europe, and various seditions were concerted against the pontiffs, which, even with the aid of barbarous inquisitors, they were unable to crush entirely. In this state of affairs, the pontiffs were under the necessity of devising new methods to obtain wealth; for which purpose they not only sold indulgencies to the people more frequently than they had formerly done, whereby they rendered themselves odious to several potentates, but also disposed publicly of scandalous licences, for which they extorted considerable sums of money. The Gallic pontiffs abolished the right of election, and arrogated to themselves a power of conferring all the offices of the church, whether great or small, according to their fancy. Under their government, too, reserves, provisions, expectations, and other odious impositions, first became familiar to the public ear, and disgusted all Europe.

The election of Clement V. to the pontificate was a matter of policy on the part of the French monarch, who looked upon a French pontiff, in whose zeal and compliance he could confide, as necessary to the execution of his designs. Accordingly, that pontiff was a mere creature of Philip, who directed and governed him as long as he lived. Inflamed with the desire of revenge, Philip insisted upon the formal condemnation of Boniface by the court of Rome, the abolition of the order of Templars, and other concessions of great importance, which he could not reasonably expect from an Italian pope. But when he ordered the dead body of Boniface to be dug up and burnt, Clement found means to avert this infamy, and had the ingenuity to promise obedience to the king in every thing else; an obligation which bound him to abrogate the laws enacted by Boniface to grant the French monarch a bounty of five years tithes, fully to absolve Nogaret, the implacable enemy of the late pontiff, and also to call a general meeting at Vienne for the condemnation of the Templars. Thus the king ordered matters as he pleased, without opposition from the pope, who dreaded his power, and had learned prudence by the melancholy fate of Boniface.

In the year 1314 Clement died, and fierce contentions arose in the conclave relative to the election of a new pontiff. The French cardinals insisted upon a French, while those of Italy would hear of none but an Italian pope; and after a contest, which lasted two years, the French party prevailed. James D'Euse, a native of Cahors, and cardinal bishop of Porto, was accordingly raised to the pontificate by the title of John XXII.; but, in consequence of a dispute in which he engaged with Louis of Bavaria, who, as a reward of his victory over Frederic of Austria, claimed the imperial crown as his right, he was, in return for his gross arrogance, deposed from his office, and one of his bitterest enemies, Peter De Corbieri, was elected in his stead. This individual was a Franciscan monk, and took the name of Nicholas V. He crowned the emperor in a solemn manner at Rome, but afterwards abdicated the papal chair, and surrendered himself to John, who kept him in confinement at Avignon during the remainder of his days. The contest between the duke of Bavaria and John XXII. thus came to a termination, and each continued in the possession of his respective rights notwithstanding their attempts to dethrone each other. After the death of John, which happened A. D. 1834, a long contest ensued about the election of a successor, and James Fournier, a Frenchman, and cardinal of St. Prisca, was chosen by the cardinals. This pontiff, whose papal name was Benedict XII. is said to have ruled the church with prudence and moderation. He put an end to the quarrel with the Emperor Louis, and laboured to redress, as far as was in his power, the grievances of the church. Had he lived, much good might have been accomplished by him, but his reign was too short to realize his schemes of reformation; and his successor, Clement VI., who was a Frenchman of the name of Peter Roger, was a man of a very different disposition. Clement was avaricious and arrogant in the extreme; he renewed the dissensions that had formerly subsisted between Louis of Bavaria and the Roman see, and, by assailing the emperor with his thundering edicts, excited the German princes to elect Henry VII., son to Charles IV., emperor in his place—a measure which would certainly have given rise to a civil war in Germany, had not Louis died in the year 1347. The government of Clement was remarkable for nothing but his unbounded zeal for the extension of the papal authority and for the addition of Avignon (which was purchased from Joan Queen of Naples) to the patrimony of St. Peter. He died in the year 1352, and was succeeded by Stephen Albert, bishop of Ostia, who took the name of Innocent VI., and governed the church with moderation for about ten years. William Grimoard, abbot of St. Victor at Marseilles, succeeded Innocent by the title of Urban V., and, by the entreaties of the Romans was induced to return to Rome in the year 1367. Returning to Avignon, however, in 1370, to reconcile the differences that had arisen between the Kings of England and France, he died there shortly after his arrival. According to the Romish writers, Urban was entirely free from all the grosser vices that had debased many of his predecessors.

Upon the death of Urban V. a French ecclesiastic of the name of Peter Roger was raised to the papal chair by the title of Gregory XI. In 1374, the Florentines, in conjunction with the Visconti of Milan, invaded the territories of the church, and made themselves masters of several cities, on which occasion, Gregory, finding his remonstrances of no avail, issued out a bull of excommunication against the invaders, which had the effect to check the commerce of the Florentines, who, therefore, endeavoured to make a reconciliation with the apostolic see. The terms proposed by the pope could not be agreed to, and hostilities commenced with ardour on both sides, in which the invaders were not without success. Gregory visited Rome in 1377, but had soon to repent of his having left Avignon, for the Romans and Florentines made no scruple to insult him with the grossest abuse. He was about to return to his usual place of residence, when he died suddenly in the year 1378.

By the long absence of the popes from Rome, their authority was at length reduced to a very low ebb. When the cardinals were assembled to appoint a successor to the vacant dignity, the people of Rome, unwilling that a Frenchman should be elected, came in a most tumultuous manner to the conclave, and demanded that the popedom should be conferred on an Italian. Terrified by the clamours of the people, the cardinals immediately proclaimed Bartholomew Pregnano, who was a Neapolitan and archbishop of Bari. He took the name of Urban VI., but such was his arrogance, that people of all ranks, especially the leading cardinals, became disgusted at him, and declared that his election to the pontificate was a mere ceremony, which had been performed for no purpose but to quell the turbulent rage of the multitude. A new pontiff was therefore elected in his stead, namely, Robert, count of Geneva, who took the title of Clement VII. He went to Avignon, and his cause was espoused by France, Spain, Scotland, Sicily, and Cypress; while Urban, who remained at Rome, was acknowledged by all the rest of Europe to be the true vicar of Christ.

At the death of Gregory XI. the union of the Latin church, under one head, was destroyed. The dissension, commonly called the great western schism, was immediately after fomented with alarming success, insomuch that, within the space of fifty years, the church had two or three different heads at the same time; the contending pontiffs forming plots and thundering out invectives against their competitors. This dissension was the occasion of great distress and calamity, and of extinguishing, in many, all sense of religion. These contentions, however, were, by their consequences, very conducive both to the civil and religious interests of mankind, by giving an incurable wound to the papal power.

The Italian cardinals attached to the interests of Urban VI., upon the death of that pontiff in the year 1389, set up for his successor at Rome, Boniface IX., a Neapolitan, whose original name was Peter Thomacelli. In 1394, Clement VII. died, and the French cardinals immediately chose for his successor Peter de Luna, a Spaniard, who assumed the appellation of Benedict XIII. About the close of the year 1394, Boniface became extremely obnoxious to the people, owing to his arbitrary exercise of power, and he would have been destroyed by the enraged multitude, had not Ladislaus, king of Naples, who happened to be then at Rome, interposed in his behalf. He retired to Perugia not long after. From Perugia he went to Assisi; but, on the approach of the jubilee year, 1400, the Roman people deputed an embassy to invite him to Rome. Their motive for giving his holiness this invitation was a desire, more especially on the part of the pecuniary interests affected, that the jubilee might be celebrated with the usual solemnity, which could not well be done in the absence of his holiness the pope. Boniface was consequently well received at Rome. He was there invested with extraordinary powers, in the exercise of which he repaired and fortified the walls and towers of the city and the castle of St Angelo, and also placed garrisons in them. While these transactions were going on, various methods were devised for redressing the grievances of the church. Neither of the popes, however, would give up the pontificate, and, for this reason, the Gallican church, in a council held at Paris A. D. 1397, solemnly renounced all subjection and obedience to both pontiffs; and in the following year Benedict was, by the express orders of Charles VI. taken prisoner in his palace at Avignon.

After the death of Boniface IX., which took place in the year 1404, the papal dignity was, by the cardinals attached to that pontiff's party, conferred on Cosmo de Meliorati, and he held it for two years with the title of Innocent VII. He was succeeded by Angelo Corrario, a Venetian cardinal, who governed the faction under the appellation of Gregory XII. With the view of healing the breach that distressed the papal empire, a plan of reconciliation was now formed, but it proved abortive, owing to the scandalous behaviour of the contending pontiffs, against whom, in a council held at Pisa A. D. 1409, a heavy sentence of condemnation was pronounced, declaring them guilty of heresy, perjury, and contumacy, unworthy of the smallest honour or respect, and separated *ipso facto* from the communion of the church. In consequence of this decisive step, a new pontiff was immediately after elected in their stead, namely, Alexander V. who before his elevation to the papacy was called Peter of Candia. But the condemned pontiffs, unappalled by the decrees and proceedings of this famous council, persisted in maintaining their rights. Benedict held a council at Perpignan, and Gregory assembled one near Aquileia in the district of Friuli. The latter, however, dreading the resentment of the Venetians, fled from Aquileia to Caieta, whence he removed to Rimini in the year 1412.

Three great factions now divided the Christian church, the three contending chiefs of which reciprocally loaded one another with anathemas and excommunications. Upon the death of Alexander V. the cardinals attached to his party chose as his successor Balthasar Cossa, known in the list of the popes by the name of John XXIII. This man was a Neapolitan, whose character by no means savoured of religion or probity. He summoned a general council at Rome, in which the writings of Wickliff were condemned and ordered to be committed to the flames. Another general council was held at Constance in 1414, for the purpose of redressing the evils of the church, and uniting it wholly under one head. In the following year John was deposed, and Gregory solemnly resigned the pontificate. The deposition of Benedict took place about two years afterwards, when Otto de Colonna was, by the unanimous suffrages of the cardinals, elevated to the papacy under the title of Martin V. Benedict, who still resided at Perpignan, was far from being disposed to submit either to the decree of the council which deposed him, or to the determination of the cardinals with respect to his successors. He obstinately asserted his rights to the papal dignity until the day of his death; and when he was dead, two cardinals, under the auspices of Alphonso king of Sicily, appointed in his place a Spaniard of the name of Giles Munoz, who assumed the title of Clement VIII. But this pontiff, finding himself inadequate to the task of ruling the church, soon resigned his pretensions to the papacy.

About this period the writings and opinions of Wickliff became well known at the university of Prague, where John Huss lived in the highest reputation on account of the sanctity of his manners, the purity of his doctrine, and his uncommon erudition and eloquence. The papal authorities took the alarm at the freedom with which this individual not only maintained the opinions which he had adopted, but also exposed the vices and corruptions of the clergy, from the pontiff to the meanest ecclesiastic; and they accordingly determined to effect the destruction of the reformer. By order of the council of Constance, in the year 1415, Huss was condemned to the flames, a punishment which he suffered with the utmost resignation and magnanimity. In the following year Jerome of Prague, the pupil and zealous friend of John Huss, experienced a similar fate. See Huss, John.

The reformation of the church of Rome, Martin V. frustrated by all possible means. The council of Constance was dissolved in April 1418, after it had sat three years; and the members postponed to a future assembly of the same kind, which was to be assembled five years after this period, their design of purifying the church of its corruptions. The proposed meeting did not take place till about thirteen years afterwards, and Martin V. died suddenly in the year 1431, just about the time when the council was to meet at Basil.

Gabriel Condolmerio, a native of Venice, and bishop of Sienna, succeeded to the papacy by the title of Eugenius IV. He approved all the measures of his predecessor relative to the assembling of the council at Basil, which was accordingly opened under the superintendance of a cardinal of the name of Julian Caesarini, who performed the functions of president, instead of Eugenius. The pope, however, soon saw cause to dread the prospect of a reformation, and therefore immediately issued his bull declaring the council to be dissolved, and appointing another to be convened at Bologna, eighteen months after; which bull, however, he was compelled to revoke in the year 1433, owing to the firmness of the council, and the interference of the emperor. By proceeding vigorously with their measures, the council provoked Eugenius to such a degree, that he came to the determination either to effect its removal into Italy, or to set up a new council in opposition to it; and a violent contest between his holiness and the council was the consequence. The decree of the pope for the dissolution of the council, and the assembling of another at Ferrara, was totally disregarded by the council, which, with the consent of the emperor and several other princes, continued its deliberations at Basil, and, in the year 1437, pronounced a sentence of contumacy against Eugenius. The pontiff, notwithstanding, in the following year, opened in person the council which he had appointed to meet at Ferrara, and, at the second session thundered out an excommunication against the fathers assembled at Basil. In 1439, the pope translated the council to Florence, where a pretended union was effected between the Greek and Latin churches, which being violently opposed at Constantinople, was rendered null and void. Eugenius was, in the meantime, deposed from the papacy by his opponents at Basil, who dispatched nuncios to the different courts of the Christian princes, to acquaint them of the circumstance. In vain did the pontiff denounce anathemas against the council, for another was raised to the papal throne, namely, Amadeus, duke of Savoy, who took the title of Felix V.

In consequence of the election of Felix, that schism which had formerly rent the church for a time was revived, and the flame of discord was kindled not only between rival popes, but also between the councils of Basil and Florence. The rival popes and rival councils anathemized each other, laying claim to the true apostolic powers. Eugenius was supported by France, Italy, Spain, Portugal, Hungary, and England, while Felix was supported by the people of Savoy, by the Swiss, and by the dukes of Bavaria and Austria. Eugenius afterwards obtained the support of the German princes, but was cut off by death when his affairs were beginning to revive.

Under Nicholas V. who succeeded Eugenius in the papal dignity, the European princes successfully exerted themselves for the restoration of tranquillity and union in the Latin church; so that a treaty of peace was proclaimed, A. D. 1449. Nicholas soon rendered himself popular by his ardent zeal for the propagation of the liberal arts and sciences. He evinced his ardent love for learning, by collecting from the ruins of the Byzantine libraries, and from the darkest monasteries in Germany and Britain, the MSS. of the writers of antiquity; and such was his industry, that in a reign of eight years he formed a library of 5000 volumes. The capture of Constantinople by Mahomet II. which took place in 1453, is supposed to have been a source of great unhappiness to this pontiff. After that event he exerted himself, but without success, during the remainder of his reign, to allay the civil wars in Italy, to reconcile the Christian princes who were then at war with one another, and to unite them in one league against the enemies of the Christian church.

Upon the death of Nicholas V. which happened in the year 1455, Alphonso Borgia, a native of Spain, who took the name of Calixtus III. obtained the pontificate, but his reign was of short duration. He was succeeded by Æneas Sylvius Piccolomini, who assumed the denomination of Pius II. This pontiff rendered his name illustrious by his lively genius and the various productions with which he enriched the republic of letters; but the lustre of his fame was tarnished by his assiduous exertions to extend the papal power, which, before his elevation to the pontificate, he had zealously opposed. (See Pius II.) He was succeeded, in the year 1464, by Paul II. a prelate whose administration was distinguished by some measures which, if we consider the genius of the times, were not unworthy of praise. The following pontiffs, Sixtus IV. and Innocent VIII. whose names were Francis Albescola and John Baptist Cibo, were neither remarkable for their virtues nor their vices. They were succeeded by Roderic Borgia, a Spaniard by birth, known in the list of the popes by the title of Alexander VI. and distinguished only for his unprincipled behaviour, which shewed that there was a Nero among the popes as well as among the emperors. The profligate career of this pontiff was continued till the year 1503, when the poison which he and his son had prepared for the destruction of a number of cardinals who stood in the way of their avarice, was, by the mistake or design of those who were employed to administer it, swallowed by the pope. (See Borgia, Cæsar.)

Pius III. succeeded Alexander in the pontificate, but died shortly after he had obtained that dignity. The next pontiff was Julius II. whose original name was de la Rovere. He obtained the pontificate by fraud and bribery, and dishonoured it by enormous crimes as well as by the most audacious arrogance, the most despotic vehemence of temper and the most extravagant and frenetic passion for war and bloodshed. Such, indeed, was the tyranny of this papal Nero, that several cardinals, encouraged by the protection of Louis XII. of France and the Emperor Maximilian, assembled, in the year 1511, a council at Pisa, to oppose his measures, and also to correct and reform the errors and corruptions of the church. Enraged at this step on the part of the cardinals, Pius gave orders for a council to meet in the Lateran palace in the year 1512, in which were condemned the decrees of the council of Pisa. He died in the same year, in the midst of his ambitious and vindictive projects.

Leo X. the successor of Julius, though a promoter of learning, was equally indifferent about the interests of religion and the advancement of true piety. He took the utmost care that nothing should be transacted in the Lateran council (which Julius had assembled and left sitting) that had the least tendency to encourage the reformation of the church; and in a conference which he had at Bologna with Francis I. of France, he engaged that monarch to abrogate the Pragmatic sanction, which had been long odious to the Roman pontiffs, and to substitute in its place another body of laws more favourable to the papacy, which he accordingly imposed upon his subjects under the denomination of the Concordat. Indeed Leo did not lose sight of the grand object which the generality of his predecessors had so much at heart, that of promoting and advancing the opulence and grandeur of the Roman see. The reign of Leo is not a little remarkable, as in his time events transpired which form an era in the annals of history. Concurring circumstances had enabled the pontiffs to look upon their own authority and the peace of the church as beyond the reach of danger; but the time was now arrived when the papal power was to receive a fatal shock. The prodigality, luxury, and imprudence of Leo exhausted his treasury, and it was found necessary that some means of accumulating wealth should be devised. The sale of indulgences was, among other means, had recourse to,—a traffic which very much disgusted the pious and wise, and which was warmly protested against by the celebrated Luther. This reformer published a set of propositions, wherein he called in question the authority of the pope to remit sins, and made some keen strictures respecting the sale of indulgences, by which means a great revolution began to take place in men's religious opinions; in consequence of which it was at length determined to condemn both him and his doctrines, and a bull was accordingly issued for that purpose, which caused a total separation between the papal see and the reformers. Luther's writings were publicly burnt, and this injury he retaliated by an equally public conflagration of the papal decrees and constitutions, and even the bull itself. Owing to these proceedings he attracted the notice of the imperial court, which Leo was desirous of gaining on his own side. The emperor resolved to protect Luther, but he was for the second time denounced as a heretic, and all persons were prohibited from either printing, selling, or reading his works. To impede the progress of the reformation, Leo X. engaged all the force of the pen as well as of the civil power. About this time the pope, to support his tottering power, conferred on Henry VIII. of England the title of Defender of the Faith; but the pope's wavering conduct respecting Henry's divorce from his queen so provoked his majesty, that he actually abandoned the control of Rome and espoused the cause of Luther and the reformation. Several attempts were notwithstanding made by the pope to extend the dominion of the church. In the latter part of his life he was implicated in contests with foreign states. He engaged a large body of Swiss in his service, who, under the pretence of different measures, made considerable progress against the French, and drove their troops before them; but while preparing to celebrate these successes in a pompous manner at Rome, he was seized with a disorder which in a few days put a period to his life, in 1521, when he was in the 46th year of his age. (See Leo X.)

After the death of Leo the conclave was divided about the choice of a successor. The younger members were attached to Julio, cardinal de Medici, the nephew of Leo, while the old cardinals disapproved of choosing the new pontiff out of the powerful family of the Medici. They afterwards made choice of Cardinal Adrian, probably through the secret interference of John Manuel, who was desirous to obtain a pope devoted to his master's interest. By his disposition and views, as well as by his principles and manners, Adrian was by no means well adapted for the pontificate; and indeed it may be conjectured that the election of that individual was merely a manœuvre to save time. He was very unpopular, and his reign lasted only one year and ten months. It is worthy of remark, that while Adrian demanded a zealous execution of the imperial edict against Luther and his followers, he declared a disposition to exercise his spiritual authority for the reformation of the church.

Cardinal de Medici next succeeded to the papacy by the title of Clement VII. From his great talents and long experience in business, and from his having in his hands the government of Florence, together with the wealth of the family of Medici, this person was considered well qualified for defending the spiritual interests of the church, and for conducting in an able manner its political operations. At the election of Clement, Wolsey, whose ambitious views were thereby thwarted, felt very indignant; but he was somewhat soothed by having conferred upon him the grant of a commission to be legate in England during life, with such ample powers as vested in him almost the whole papal jurisdiction in that kingdom. An alliance was concluded in the year 1526 between the pope, the Venetians, and Sforza duke of Milan, for the security of Italy, which was acceded to by the king of France and Henry VIII. of England, and which was called the Holy League, because the pope was at the head of. As soon as this league was concluded, Clement, by the plenitude of his papal power, absolved Francis from the oath which he had taken to observe the treaty of Madrid; but the discovery of Francis' intentions to elude this treaty filled the emperor with a variety of disquieting thoughts, and he determined to insist on the strict execution of it, and vigorously exerted himself in order to send supplies of men and money into Italy. An active part against the confederacy was taken by the Colonnas, who retained their attachment to the imperial interest: For some time, they deluded the pope in respect of their designs; but they at length marched against Rome, and made themselves masters of the city. Clement was soon obliged to urge a capitulation; and the imperial ambassador, Moncada, in the most haughty manner prescribed conditions which it was not in his power to reject. Regardless of the treaty with Moncada, Clement degraded the cardinal Colonna and excommunicated the rest of the family; but they were not long of retaliating on the pope. The city was again taken by the imperial army under the command of the duke of Bourbon; and Clement, who, terrified at the danger which threatened him, ashamed of his own cruelty, and deserted by almost every person, had shut himself up in the castle of St Angelo, was reduced to such extremity of want that he was glad to capitulate on any conditions. The terms prescribed and agreed to were, that he should pay 400,000 ducats to the army, and surrender to the emperor all the places of strength belonging to the church; and until the chief articles were performed he was to remain a prisoner. On hearing of the pope's captivity, the Florentines ran to arms, expelled the cardinal De Cortona, who governed their city in the pope's name, defaced the arms of the Medici, demolished the statues of Leo and Clement, and declaring themselves a free state, re-established their ancient form of government. The emperor at length concerted measures to set the pope at liberty, the treaty for which was speedily concluded on condition of Clement allowing 250,000 crowns for the use of the army, and paying the same within a specified time. These disastrous events tended not a little to favour the progress of Lutheranism. In a diet of the empire, held at Spires in the year 1526, the state of religion came to be considered, and all that the emperor required of the princes was, that they would wait patiently for the meeting of a general council which he had demanded of the pope. During the meeting of the diet at Spires, however, the divines who attended thither the electorate of Saxony and landgrave of Hesse Cassel, were bold enough to preach publicly, and administer the sacraments according to the rites of the reformed church. By the Germans, the papal authority was now treated with little reverence, and a manifesto against the pope was industriously circulated over that country, which more than counterbalanced the effects of Charles' declarations against the new opinions. Having seen so many provinces and kingdoms revolt from the holy see, Clement now became apprehensive lest England should follow their example; and, therefore, determined to give Henry the VIII. such satisfaction as might still retain him within the bosom of the church. This, however, he was prevented from accomplishing, by the violence of the cardinals devoted to the emperor; the papal power and jurisdiction in England was abolished by an act of Parliament, and, by another act, all the authority of which the popes were deprived was vested in the king, who was declared supreme head of the church. (See BRITAIN and MONASTERY.) The pontificate of Clement was the most unfortunate that the Romish church had known for many ages.

After the death of Clement VII. which happened in 1534, Paul, a Roman by birth, whose original name was Alexander Farnese, filled the papal chair. Like his predecessors, this prelate was averse from any scheme for reforming either the doctrines of the church or the abuses of the court of Rome. He was disposed to crush the progress of the reformation; but his attention was unavoidably occupied with other objects, and the weakness of his measures ultimately became the object of contempt to all Christendom. He died in the year 1549, after a reign of about fifteen years.

The successor of Clement VII. was John-Maria Del Monte, known in the list of the popes by the title of Julius III. He held the Roman see about five years, and was succeeded by Marcellus II. who survived his consecration only one month.

Paul IV., whose original name was Caraffa, next obtained the papacy, which he held for about four years. In his administration he aimed chiefly at the eradication of heresy by means of the tribunal of the inquisition, which he ordered to take cognizance of several crimes which had formerly been under the jurisdiction of the other courts,—a measure by which he deservedly incurred universal odium.

John Angelo di Medici, who took the name of Pius IV. was chosen to succeed Paul. In a council summoned by him at Trent, A. D. 1562, attempts were made to abridge the authority of the pope; but he managed matters in so conciliatory a manner, that, before the assembly was dissolved, decrees were passed, designed as an acknowledgement of the subordination of the council to the apostolic see. By the severity and oppression of his government, this pontiff forfeited the good will of the Roman people. He died unlamented in the year 1565, after he had held the Roman see about six years.

Pius V. who next succeeded to the papacy, soon rendered himself odious by his persecution of the Protestants; for, not satisfied with his endeavours to extirpate the reformed opinions out of Italy, he, in 1568, encouraged Charles IX. of France to make war upon the Protestant subjects; and he permitted some of the estates of the church in France to be alienated in order to supply funds for carrying on hostilities. He published a bull in the same year, containing anathemas against such persons as should appeal to general councils from the decrees of the popes, and against those princes who should impose restraints on ecclesiastical jurisdictions, or exact contributions from the clergy. This absurd bull was not received in any kingdom out of Italy; and another one which he issued, excommunicating Queen Elizabeth, and absolving her subjects from their allegiance, was treated with contempt. Pius died in the year 1572, after having ruled the church about six years, and was succeeded by Gregory XIII.; the most important event in whose pontificate was the reformation of the calender.

The successor of Gregory was Sixtus V. whose original name was Felix Peretti di Montalto. The administration of this pontiff was remarkably rigorous, insomuch that he was ranked among the most distinguished characters of the age. France was in confusion at the time of his election, on account of the machinations of the Catholic league to exclude from the crown its presumptive heir, Henry, king of Navarre. At the head of the Catholic church, Sixtus thought it became him to promote the exclusion of a Protestant heir. He therefore denounced sentence of excommunication against that sovereign, depriving him of the right of succession; and he afterwards approved openly the assassination of Henry. To the Jesuits, Sixtus was a decided enemy. He was indignant that they should assume a name, implying that the meek and benevolent Jesus was their founder. He reigned above five years, and died in 1590. Nothing worthy of particular notice occurred in the short reigns of the three succeeding pontiffs, namely Urban VII., Gregory XIV., and Innocent IX.

Clement VIII., whose original name was Hippolito Aldobrandini, succeeded to the papal chair in the year 1592. In his time the famous controversy arose between the Jesuits and Dominicans, concerning grace, free-will, and predestination, which was carried on till the year 1594. Clement, during his reign, exerted himself very much to extinguish the Protestant religion, and extend the limits of the Romish church.

In the year 1605, Leo XI., of the house of Medicis, was elected to the pontificate. By his death, which happened shortly after, the papal chair was left open to Camillo Borghese, who assumed the denomination of Paul V. This pontiff distinguished himself chiefly by his zeal for advancing the ecclesiastical authority and jurisdiction of the papal see. He published, in the year 1619, an universal jubilee, in order to implore the assistance of the Almighty for the defence of the church, which was endangered by a general insurrection of the Protestants in Bohemia, and other countries under the Austrian dominions, who had been provoked to fly to arms by the oppressions with which they had been harrassed. A signal victory was, in the same year, gained over the insurgents, but the pope died at Rome shortly after.

The successor of Paul was Gregory XV., the founder of the famous college *De Propaganda Fide.* He was a zealous promoter of the interests of the Catholic church, and shewed no clemency to heretics. As the Hugonots of France had, by the violation of the edict of Nantz, been driven to take up arms in their own defence, the pope wrote to Louis XIII. exhorting him to destroy or extirpate them, and at same time issued a bull for the purpose of animating the papists in their sanguinary and barbarous undertaking.

Upon the death of Gregory, which happened in the year 1623, Maffei Barberini succeeded him in the papal throne by the name of Urban VIII. All who bore the name of Protestants were by him treated with the utmost severity. But, in comparison of his successor, Innocent X. of the family of Pamphili, he may be considered as a good and equitable ruler. Urban was a man of letters, and a magnificent patron of learning and genius. Innocent X., who was both illiterate and profligate, abandoned the government of the church to the disposal of a base woman of the name of Donna Olympia. In the year 1655, Fabro Chigi obtained the papal chair, and took the title of Alexander VII.; but his pontificate was not distinguished by any transactions worthy of notice. After him the two Clements IX. and X. were elected successively to the papacy. Benedict Odeschalchi was placed at the head of the church in the year 1677. He assumed the name of Innocent XI., and, by his wise and salutary regulations, shewed himself truly worthy of the high dignity conferred upon him. Innocent was unwearied in his endeavours to suppress superstition, to reform the corrupt manners of the clergy, and to stem the torrent of licentious morals among the laity. He died in 1689, having presided over the Roman see about twelve years. His successor was Peter Ottoboni, who assumed the name of Alexander VIII. but shewed himself incapable to govern the church with any degree of prudence or wisdom. Pignatelli succeeded Alexander by the title of Innocent XII. in the year 1691. He happily exerted himself to reform the manners of the clergy; and so anxiously devoted was he to the interests of the poor, that the wealth which many of his predecessors had been accustomed to accumulate, or to bestow on worthless relatives, was by him devoted to the erection of hospitals and other useful institutions. All his prudence and resolution, however, were inadequate to the accomplishment of his designs of reformation; and he died in the year 1700, after he had ruled the church nine years.

Clement XI., originally John Francis Albani, succeeded Innocent in the papal chair, and began his high career with abolishing abuses both in church and state. He laboured to prevent a war taking place between the king of France and the emperor on the subject of the Spanish succession, but his attempts were without success. He testified much zeal to promote the diffusion of the Catholic faith, and sent legates into Persia, India, China, and other regions, to extend the knowledge of Christianity.

After the death of Clement, which happened in the year 1721, the pontifical chair was filled by Innocent XIII., originally named Michael Angelo Conti. This pontiff died shortly after his election, and was succeeded by Cardinal Vincent Orsini, eldest son of the duke of Gravina, who assumed the title of Benedict XIII., and whose administration was remarkably wise and prudent. He embraced every opportunity of discouraging luxury and vice, and inculcating morality and religion; and with the view of diffusing scriptural knowledge, he permitted the people in general to peruse the sacred volume, and encouraged the multiplication of copies in the modern languages. He conceived a scheme for uniting the four communities that divided Christendom, namely the Romish, Greek, Lutheran, and Calvinistic churches; which scheme, however, he was unable to carry into execution. This respectable ruler of the Romish church was not only indefatigable in his official duties, but was, in private life, exemplary for every good quality. That he might be enabled to relieve the wants of the poor, he accustomed himself to self-denial, and lived like a hermit in his cell.

The successor of the mild and humble Benedict was Clement XII. of the family of Corsini, who began his career by reforming the abuses which had crept into the administration of the state; and, throughout his reign, showed himself to be a man of eminent abilities, and actuated by noble principles. He possessed a taste for the fine arts, and was a liberal patron of learned men. He checked in the catholic states the practice of pluralism, and zealously opposed the progress of Jansenism in France.

Upon the death of Clement in 1740, Prosper Laurence Lambertini, archbishop of Bologna, was raised to the pontificate by the title of Benedict XIV. Perceiving the relaxed morality of the clergy in the catholic states, Benedict had recourse to conciliatory measures to check their licentiousness. He was disposed to reconcile all religious differences among Christian communities, but his powers were inadequate for so Herculean a task. He was an erudite theologian, and a liberal patron of learning and the fine arts, and in his administration he was mild and conciliatory rather than rigid or severe.

After the death of Benedict, the pontifical chair was filled by Cardinal Rezzonica, bishop of Padua, under the title of Clement XIII. This pontiff was less esteemed than his predecessors, though his reputation for piety was not inferior, nor his zeal for the high claims of the church less fervid. In several states the Jesuits became, during his pontificate, extremely obnoxious; but the enemies of that order strove to effect their dissolution, and conceived strong hopes of accomplishing their purpose when a prelate of a more philosophical character should be chosen pontiff.

In the year 1769 a Franciscan monk, of the name of Francis Laurence Ganganelli, obtained the purple, and assumed the denomination of his immediate predecessor. Ganganelli is said to have been remarkably unprejudiced, candid, and liberal in his administration, and to have had neither the bigotry of a monk nor the pride of a cardinal, neither the ferocity of an inquisitor nor the rapacity of an indigent adventurer suddenly exalted to power and sovereignty. In the fifth year of his pontificate, he came to the resolution to disembody the Jesuitical order, and amalgamate its members with the unprivileged mass of society, from a persuasion that that order had ceased to answer the ends of its institution, and that the members, by the impropriety of their conduct, their loose casuistry, and their mischievous arts, had forfeited all claim to farther encouragement. A bull was accordingly promulgated for the annihilation of the fraternity; and Lorenzo Ricci, the refractory general of the order, was sent to the castle of St Angelo,—a measure the justice and expediency of which was generally approved by the courts of Europe.

John Angelo Braschi succeeded Clement XIV. as Pius VI. and commenced his administration with acts of benevolence and charity, with the selection of deserving men for various offices, and the removal or discouragement of unworthy individuals. During the first years of his pontificate, which were perfectly tranquil, he prosecuted a work which some emperors had attempted in vain, by draining the Pontine marshes, which extended about 40 miles round Vellari, Terracina, and Piperno. He also caused immense canals to be dug, in order to carry off the water, and recover a considerable extent of fertile land from the marshes. Along the banks of these canals, which were ornamented with four rows of poplars, he made a road nearly 40 miles in length, terminating with an elegant palace. After the suppression of the order of Jesuits, many who had belonged to the fraternity found protection in the dominions of the king of Prussia, who intimated to the new pope that he was not disposed to pay any regard to the edict against that body. At the instigation, however, of the ministers of France and Spain, the pope afterwards required that the habit of the dissolved order should be no longer worn in the territories of Frederic; and that none of the ex-Jesuits should either preach or administer the eucharist or other sacraments. The monarch, adverting to the ability which the Jesuits had displayed in the task of education, expressed a desire that they should remain as a society for that purpose in those provinces in which his Catholic subjects were numerous; and when Pius conceded this point, the king agreed to the requisitions of the pontiff. The tranquillity of Pius was interrupted on the accession of the emperor Joseph II. who had a strong inclination to abridge the papal power, and was not to be diverted from his purpose by the entreaties or remonstrances of the pope. The see of Rome ultimately lost the presentation to bishops in Lombardy and other Austrian dependencies; its nuncios were deprived of their power and jurisdiction in Germany; and by these and other attacks the lustre of the papacy was evidently eclipsed. The revolution of France, and the consequent overthrow of all form of religion, very much disgusted Pius, who, notwithstanding, did his utmost to preserve peace with the republic. Apprehending that his menaces and edicts would be disregarded by the revolutionists, and might only serve to provoke embittered hostilities, he endeavoured to secure the friendship of those princes whose power might afford him some protection amidst the revolutionary storm. But his opposition to the proceedings of revolutionary France was altogether unsuccessful, and only furnished the directory with a pretext, such as they were waiting for, to overthrow the papal power, turn Rome into a democracy, and carry the pope a prisoner to France, where he died in 1799, in the 82d year of his age.

Cardinal Di Chiaramonte, who took the title of Pius VII. was elected to the pontificate by a conclave, held at Venice, by order of the emperor of Germany, after the church had subsisted for some time without a head. The public history of this pontiff is intimately connected with that of France and Napoleon Bonaparte. When Napoleon acquired the dignity of first consul or sovereign of France, one of his first measures was the re-establishment of the Catholic religion under certain restrictions, and with certain modifications as to forms and powers; and he at same time gave a toleration to all other religions. The pope was pleased at the preference given to Catholicism, although he was well aware that his influence over the Gallican church would be very inconsiderable. In 1804 he was required to repair to France, in order to give solemnity to the coronation of the Emperor. His holiness accordingly crossed the Alps, and was escorted to Paris by a strong guard of French troops, and 250 hussars, who were ordered to meet him on the frontiers of the French territory. While Bonaparte was at Vienna in the summer of 1809, he caused proclamation to be made in the public squares and market places of that city, that, from the first day of June, the papal territory should be united with the French empire; that Rome should, at the same time, be declared a free and imperial city; and that the annual revenue of the pope should be fixed at two millions of francs. The pope solemnly protested against the violence and injustice by which he had been stripped of his temporal sovereignty, and at same time issued an act of excommunication against the emperor and all his cooperators in this act of unprovoked spoliation. The thunders of the Vatican, however, had lost their terrors; and an act, which three centuries ago would have roused to arms all the states of Europe, was now witnessed without one single effort on the part of the surrounding sovereigns to pluck their prey from the hands of the spoilers. Pius VII. was for a considerable time placed in circumstances the most perplexing and distressing; but early in the year of 1813 a reconciliation was effected between the head of the Romish church and the Emperor of France, and Napoleon agreed to restore the pope to his temporal power and to reinstate him in his former dignity; in consideration of which act of condescension the holy father abrogated the decree of excommunication fulminated against Napoleon, and sanctioned his marriage with the daughter of the emperor of Germany. On the subversion of the Napoleon dynasty, Pius resumed his authority with a firm resolution to exercise his prerogatives to their utmost extent. One of his first acts was the public restoration of the order of Jesuits, and a few days afterwards followed the promulgation of an edict for the re-instatement of the monastic communities. Among many other acts of a similar nature, he issued a papal bull, denouncing the Bible Society as a conspiracy to subvert the true faith, and prohibiting any of the members of the Romish church from contributing to its support. It is not improbable that, after Napoleon's second abdication, the pope predicted for the church a long season of repose. He was, however, soon called to witness fresh disasters in the revolutions of Spain and Naples. But he lived long enough to be gratified by the triumph of despotic power in the overthrow of the Neapolitan constitutional government by the army of Austria, and to rejoice in the success of the invasion of Spain under the auspices of Bourbon bigotry. Pius VII. died at Rome in 1823, in the 81st year of his age.

On taking a cursory view of the rise, progress, and decline of popery, it may be remarked that the Romish church appears to be a political establishment, employing, indeed, religious terms and denominations, but only as the pretext and colour of an inordinate pursuit of secular and temporal objects. "Read the history of this church," says Birt, in his *Summary of Popery*, "as that of a Christian church, you stumble at every step, and every period shocks you by the grossest incongruities; read the same history as of one of the kingdoms of this world, all is natural and easy, and the various proceedings and events are just what you are prepared to expect."

The reader who is desirous to know the state of the question respecting the supremacy of the pope, may consult the works of Bellarmine, also Barrow's *Treatise on the Pope's Supremacy*, and Chilingworth's *Religion of Protestants*.

# POPULATION.

Definition. POPULATION, the state of a country with respect to the number of people. Under the head of ECONOMY POLITICAL, in the third volume of this work, we have already given an ample detail of the principles of population, consequently we need not here enlarge upon the subject.

The population of the globe has been estimated variously by different writers on political arithmetic. Riccioli has stated the total amount at a thousand millions, whereas Xavier de Feller makes it 370 millions, Vossius 500, and the journalists of Trevoux 720 millions. The Jesuits of Trevoux assuming that 6006 years have elapsed since the creation of the world, making 182 generations, have estimated the whole number of mankind that have ever existed at about one hundred and thirty thousand millions.

Respecting the advantages which a state derives from the diminution or increase of its population, different nations have formed very different opinions.

History. Some of the nations of antiquity endeavoured, by certain regulations, to prevent the increase of the inhabitants, whereas the political writers of modern times have considered the strength and prosperity of the state as consisting in its population. In countries where the wages of the labourer are high, as in the states of America, and some of the recent colonies, the inhabitants congratulate themselves on the increase of their families, as upon a new accession of wealth; whereas in some European countries a numerous family not unfrequently involves the parents and children in poverty. Mr Malthus and other political writers have therefore proposed certain means of checking this superabundant population, as the reader will observe by turning to the treatise above referred to in our third volume.

Although in most countries it has been deemed a matter of importance to ascertain the actual number of the inhabitants, yet it is only in modern times that any regular plan has been adopted for this purpose. In estimating their population most of the European governments were satisfied with the returns of the number of families, houses, or individuals sub-

History.

ject to the payment of taxes, till in 1757 the kingdom of Sweden issued a decree for a general enumeration of all its inhabitants. In imitation of their example, the United States of America, by an act of Congress of 1st March 1790, ordered a return, within nine months, of its whole population, distinguishing the number of free males, free females, and slaves, above and under the age of 16 years. This enumeration was affixed in two or three of the most public places in the district, to receive any corrections thought requisite by the inhabitants, and the amount of the population at that time was nearly four millions, including about 700,000 slaves; but in this census the inhabitants of the North-west territory were not included. The second census was transmitted to the president in December 1801, amounting to 5,305,638, of which 893,331 were slaves, thus making the increase during ten years above one-third of the whole population. If the inhabitants of that vast territory have increased in the same ratio since that time to the present, they must now exceed the population of Great Britain, as it stood in 1801. What has contributed to this rapid increase in America, is the emigration which it attracts from other countries, and the vast tracts of unsettled lands which they possess. The population of Great Britain, and the increase or diminution of its inhabitants, were never ascertained with any degree of precision till an act of Parliament was passed in December 1800, directing a general enumeration to be taken of all the houses, families, and individuals in England and Wales on the 10th March 1801, and in Scotland as soon as possible after that day. According to this census, the population amounted to 10,942,646, exclusive of the islands of Guernsey, Jersey, Alderney, Sark, the Scilly islands, and the isle of Man, the inhabitants of which are estimated at 80,000. Since that period, the population of Great Britain and Ireland has greatly increased. According to the census of 1821, in England and Wales it amounted to 12,218,500, and Scotland to 2,135,300, as may be seen from the tables annexed; and as the Catholics of Ireland have been computed at nearly five millions, and the Protestants at about two millions more, the total amount of the population may be estimated, at the present time, considerably above twenty-one millions. Drs Brakenridge and Davenant have caculated six persons to each house, but Dr Price and Mr G. King consider this allowance to be too large; and since more accurate estimates have been made, it appears that in England and Wales each house contains $5\frac{3}{5}$, and in Scotland $5\frac{2}{5}$. In large towns, such as London, Manchester, Liverpool, Bristol, and Plymouth, but particularly in sea-ports, the inhabitants are more crowded than in towns of a moderate size.

In regard to the proportion of males and females, it has been asserted that more males are born than females, but that the latter are the most numerous in the resident population, owing to the great number of males employed in foreign countries. In Europe, the number of males predominate; but in America, excepting in three or four of the states, it is the reverse; and the proportion of the total numbers is 96 females to 100 males. From the register of baptisms in Britain for 29 years, it appears that 104 males were born for 100 females. In maritime counties, however, the returns of the resident population have been very different, as there are 110 females to 100 males; which excess of females may be accounted for, as already noticed, from the great number of males in the army, navy, and merchant service, amounting in all to $11\frac{1}{2}$, or a fraction of less than 10 out of 110, none of which is included in the census at home. It seems evident that the number of males and females in the human race are as nearly equal as could reasonably be expected; and that provision has been made for maintaining this equality, in consequence of the greater casualties to which the males are exposed, in commercial pursuits, and by warfare and navigation.

History.

The population of France was taken in the 10th year of the republic, when it amounted to 33,104,343, which is considerably above what is stated in the tables below; but this census included 13 departments incorporated with it at that time, containing upwards of 5 millions of inhabitants. That the reader may be enabled to form some idea of the vast numbers of mankind which at present exist, we shall give a general summary of all the nations of the world, according to their latest returns, together with their chief cities, their distance from London, and the number of inhabitants that each nation contains. In this table, however, it may be proper to state, that Russia has five millions in Asia, that the German States include the population of Wirtemberg, Saxony, Bavaria, and Hanover, and that Turkey has ten millions in Asia, and nearly three millions in Egypt, making in all about twenty-one millions. The population tables of England, Wales, and Scotland, are taken from the returns of Mr Rickman.

*A General Summary of all the Nations in the World, together with their chief Cities, their Distance from London, and the Number of Inhabitants each Nation contains.*

### EUROPE.

| Nations. | Inhabitants. | Chief Cities. | Miles from London. |
|---|---|---|---|
| Sweden | 3 millions | Stockholm | 895 |
| Russia | 36 millions | Petersburgh | 1265 |
| Poland | $13\frac{1}{2}$ millions | Warsaw | |
| Denmark | 3 millions | Copenhagen | 565 |
| Prussia | 10 millions | Berlin | 599 |
| Netherlands | 6 millions | Amsterdam | 206 |
| German States | 25 millions | Dresden | 590 |
| Austria | 28 millions | Vienna | 730 |
| Turkey | 8 millions | Constantinople | 1500 |
| France | 29 millions | Paris | 210 |
| Switzerland | 2 millions | Berne | 445 |
| Italy and Naples | 17 millions | Rome | 863 |
| Portugal | 4 millions | Lisbon | 1010 |
| Spain | 12 millions | Madrid | 802 |
| Great Britain and Ireland, 1821. | 20 millions | London | |

ASIA.

| Nations. | Inhabitants. | Chief Cities. | Miles from London. |
|---|---|---|---|
| Turkey | 10 millions | Aleppo | 2980 |
| Russia | 5 millions | Astracan | 2149 |
| China | 333 millions | Pekin | 4999 |
| Tonquin | 21 millions | Bachin | |
| Japan | 30 millions | Jeddo | 5942 |
| Birman Empire | 17 millions | Ava | 5346, |
| Siam | 8 millions | Siam | 5560 |
| Hindostan | 85 millions | Calcutta | 4928 |
| Persia | 10 millions | Ispahan | 2951 |
| Tartary | 10 millions | Samarcand | 3127 |
| Arabia | 10 millions | Mecca | 2988 |

AMERICA.

| Nations. | Inhabitants. | Chief Cities. | Miles from London. |
|---|---|---|---|
| United States | 10 millions | Washington | 3658 |
| Spanish Dominions | 13 millions | Lima | 5699 |
| British Dominions | 2 millions | Quebec | 3161 |
| Portuguese Dom. | 4 millions | Rio Janeiro | 2573 |

AFRICA.

| Nations. | Inhabitants. | Chief Cities. | Miles from London. |
|---|---|---|---|
| Abyssinia | 2 millions | Gondar | 3376 |
| Egypt | 2½ millions | Cairo | 2183 |
| Morocco, Fez, &c | 15 millions | Morocco | 1459 |
| Algiers | ¼ millions | Algiers | 1107 |
| Tunis | ¼ millions | Tunis | 1141 |
| Tripoli | ½ millions | Tripoli | 1450 |

## ENGLAND.

| COUNTIES. of | POPULATION. 1. 1700. | 2. 1750. | 3. 1801. | Increase per cent. | 4. 1811. | Increase per cent. | 5. 1821. | 6. Area in Square Miles (English.) | 7. Divisional Meetings or Petty Sessions. | 8. Acting County Magistrates. | 9. Number of Parishes. | 10. Number of Population Returns. 1821. | 11. Number of Parish Register Returns. 1821. | 12. Annual Proportions. One Baptism to | One Burial to | One Marriage to |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bedford | 48,500 | 53,900 | 65,500 | 11 | 72,600 | 18 | 85,400 | 463 | 6 | 41 | 125 | 147 | 128 | 36 | 62 | 131 |
| Berks | 74,700 | 92,700 | 112,800 | 8 | 122,500 | 10 | 134,700 | 756 | 9 | 93 | 151 | 250 | 160 | 34 | 58 | 145 |
| Buckingham | 80,500 | 90,700 | 111,000 | 10 | 121,600 | 13 | 136,800 | 740 | 10 | 136 | 202 | 240 | 206 | 35 | 56 | 144 |
| Cambridge | 76,500 | 72,000 | 92,300 | 13 | 104,500 | 19 | 124,400 | 858 | 11 | 85 | 167 | 176 | 175 | 32 | 58 | 126 |
| Chester | 107,000 | 131,600 | 198,100 | 18 | 234,600 | 17 | 275,500 | 1,052 | 8 | 69 | 90 | 504 | 128 | 36 | 55 | 156 |
| Cornwall | 105,800 | 135,000 | 194,500 | 15 | 223,900 | 17 | 262,600 | 1,327 | 16 | 99 | 205 | 218 | 205 | 34 | 71 | 151 |
| Cumberland | 62,300 | 86,900 | 121,100 | 14 | 158,500 | 15 | 159,300 | 1,478 | 5 | 55 | 104 | 302 | 137 | 34 | 58 | 154 |
| Derby | 93,800 | 109,500 | 166,500 | 15 | 191,700 | 13 | 217,600 | 1,026 | 6 | 54 | 159 | 357 | 188 | 35 | 63 | 153 |
| Devon | 248,200 | 272,200 | 354,400 | 12 | 396,100 | 13 | 447,900 | 2,579 | 20 | 167 | 465 | 487 | 472 | 32 | 61 | 127 |
| Dorset | 90,000 | 96.400 | 119,100 | 8 | 128,900 | 14 | 147,400 | 1,005 | 9 | 63 | 271 | 309 | 267 | 36 | 66 | 154 |
| Durham | 95,500 | 135,000 | 165,700 | 11 | 183,600 | 15 | 211,900 | 1,061 | 16 | 74 | 75 | 302 | 99 | 34 | 55 | 145 |
| Essex | 159,200 | 167,800 | 234,000 | 11 | 260,900 | 13 | 295,300 | 1,532 | 14 | 188 | 406 | 431 | 405 | 35 | 59 | 150 |
| Gloucester | 155,200 | 207,800 | 259,100 | 14 | 295,100 | 16 | 342,600 | 1,256 | 18 | 179 | 339 | 459 | 341 | 37 | 64 | 119 |
| Hereford | 60,900 | 74,100 | 92.100 | 6 | 97,300 | 8 | 105,300 | 860 | 12 | 136 | 219 | 281 | 225 | 38 | 63 | 170 |
| Hertford | 70,500 | 86,500 | 100,800 | 14 | 115,400 | 15 | 132,400 | 528 | 12 | 95 | 132 | 150 | 132 | 34 | 58 | 179 |
| Huntingdon | 34,700 | 32,500 | 38,800 | 13 | 43,700 | 14 | 49,800 | 370 | 3 | 22 | 103 | 107 | 98 | 35 | 63 | 132 |
| Kent | 153,800 | 190,000 | 317,800 | 21 | 385,600 | 13 | 434,600 | 1,537 | 14 | 168 | 411 | 444 | 402 | 31 | 50 | 130 |
| Lancaster | 166,200 | 297,400 | 695,100 | 23 | 856,000 | 25 | 1,074,000 | 1,831 | 16 | 100 | 70 | 464 | 205 | 32 | 55 | 126 |
| Leicester | 80,000 | 95,000 | 134,400 | 15 | 155,100 | 15 | 178,100 | 804 | 6 | 52 | 216 | 348 | 259 | 36 | 59 | 133 |
| Lincoln | 180,000 | 160,200 | 215.500 | 14 | 245,900 | 17 | 288,800 | 2,748 | 16 | 110 | 629 | 745 | 623 | 32 | 62 | 138 |
| Middlesex | 624,200 | 641,500 | 845,400 | 17 | 985,100 | 19 | 1,167,500 | 282 | 13 | 200 | 19[illegible] | 239 | 201 | 38 | 47 | 106 |
| Monmouth | 39,700 | 40,600 | 47,100 | 36 | 64,200 | 13 | 72,300 | 498 | 10 | 39 | 125 | 158 | 127 | 47 | 70 | 154 |
| Norfolk | 210,200 | 215,100 | 282,400 | 7 | 301,800 | 16 | 351,300 | 2,092 | 33 | 154 | 731 | 751 | 694 | 33 | 61 | 136 |
| Northampton | 119,500 | 123,300 | 136,100 | 7 | 146,100 | 13 | 165,800 | 1,017 | 9 | 79 | 306 | 346 | 298 | 36 | 58 | 134 |
| Northumberland | 118,000 | 141.700 | 162,300 | 10 | 177,900 | 14 | 203,000 | 1,871 | 7 | 43 | 88 | 554 | 100 | 38 | 58 | 145 |
| Nottingham | 65,200 | 77,600 | 145,000 | 16 | 168,400 | 13 | 190,700 | 837 | 10 | 58 | 212 | 269 | 217 | 33 | 58 | 135 |
| Oxford | 79,000 | 92,400 | 113,200 | 9 | 123,200 | 13 | 139,800 | 752 | 13 | 59 | 217 | 307 | 236 | 35 | 61 | 153 |
| Rutland | 16,600 | 13,800 | 16,900 | 1 | 17,000 | 11 | 18,900 | 149 | 1 | 7 | 52 | 56 | 50 | 36 | 62 | 148 |
| Salop (Shropshire) | 101,600 | 130,300 | 172,200 | 17 | 200,800 | 5 | 210,300 | 1,341 | 11 | 109 | 216 | 508 | 234 | 35 | 58 | 155 |
| Somerset | 195,900 | 224,500 | 282.800 | 11 | 313,300 | 16 | 362,500 | 1,642 | 16 | 130 | 475 | 517 | 479 | 37 | 63 | 149 |
| Southampton (Hampsh.) | 118,700 | 137,500 | 226,900 | 12 | 253,300 | 14 | 289,000 | 1,628 | 11 | 110 | 298 | 349 | 311 | 32 | 58 | 117 |
| Stafford | 117,200 | 160,000 | 247,100 | 23 | 304,000 | 14 | 347,900 | 1,148 | 8 | 62 | 145 | 350 | 186 | 32 | 56 | 128 |
| Suffolk | 152,700 | 156,800 | 217,400 | 12 | 242,900 | 14 | 276,000 | 1,512 | 16 | 110 | 510 | 525 | 502 | 35 | 67 | 139 |
| Surrey | 154,900 | 207,100 | 278,000 | 20 | 334,700 | 22 | 406,700 | 758 | 11 | 165 | 142 | 161 | 144 | 40 | 52 | 148 |
| Sussex | 91,400 | 107,400 | 164,600 | 19 | 196,500 | 21 | 237,700 | 1,463 | 16 | 134 | 310 | 329 | 302 | 33 | 72 | 151 |
| Warwick | 96,600 | 140,000 | 215.100 | 10 | 236,400 | 18 | 280,000 | 902 | 14 | 61 | 205 | 265 | 209 | 37 | 52 | 125 |
| Westmoreland | 28,600 | 36,300 | 43,000 | 10 | 47,500 | 10 | 52,400 | 763 | 4 | 32 | 32 | 121 | 68 | 35 | 58 | 155 |
| Wilts | 153,900 | 168,400 | 191,200 | 5 | 200,300 | 13 | 226,600 | 1,379 | 16 | 91 | 300 | 388 | 314 | 37 | 66 | 145 |
| Worcester | 88,200 | 108,000 | 143,900 | 15 | 165,900 | 13 | 188,200 | 729 | 13 | 90 | 171 | 247 | 202 | 34 | 56 | 143 |
| York, East Riding | 96,200 | 85,500 | 144,000 | 20 | 175,000 | 12 | 194,300 | 5,961 | 13 | 48 | 257 | 450 | 246 | 33 | 57 | 127 |
| Do. North Riding | 98,600 | 117,200 | 160,500 | 7 | 171,100 | 10 | 187,400 | | 20 | 93 | 185 | 535 | 224 | 36 | 63 | 151 |
| Do. West Riding | 236,700 | 361,500 | 582,700 | 16 | 675,100 | 21 | 815,400 | | 19 | 110 | 195 | 668 | 298 | 35 | 61 | 131 |
| ENGLAND | 5,108,500 | 6,017,700 | 8,609,000 | 14¾ | 9,870,300 | 16⅖ | 11,486,700 | 50,535 | 511 | 3,968 | 9,860 | 14,532 | 10,487 | 35 | 57 | 133 |
| WALES | 366.500 | 449,300 | 559.000 | 13 | 632,200 | 15¾ | 751,800 | 7,425 | 84 | 462 | 833 | 1,241 | 855 | 41 | 69 | 156 |
| Totals | 5,475,000 | 6,467,000 | 9,168,000 | 14⅗ | 10,502,500 | 16⅓ | 12,218,500 | 57,960 | 595 | 4,430 | 10,693 | 15,773 | 11,342 | 35 | 58 | 134 |

## WALES.

| COUNTIES of | POPULATION. | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1. 1700. | 2. 1750. | 3. 1801. | Increase per cent. | 4. 1811. | Increase per cent. | 5. 1821. | 6. Area in Square Miles (English.) | 7. Divisional Meetings or Petty Sessions. | 8. Acting county Magistrates. | 9. Number of Parishes. | 10. Number of Population Returns. 1821. | 11. Number of Parish Register Returns. 1821. | 12. Annual Proportions. | | |
| | | | | | | | | | | | | | | One Baptism to | One Burial to | One Marriage to |
| Anglesey | 22,800 | 26,900 | 35,000 | 10 | 38,300 | 20 | 46,000 | 271 | 4 | 22 | 67 | 76 | 72 | 41 | 83 | 146 |
| Brecon | 27,200 | 29,400 | 32,700 | 19 | 39,000 | 14 | 44,500 | 754 | 6 | 43 | 66 | 120 | 72 | 53 | 67 | 158 |
| Cardigan | 25,300 | 32,000 | 44,100 | 18 | 52,000 | 13 | 59,000 | 675 | 9 | 46 | 65 | 109 | 70 | 40 | 70 | 159 |
| Carmarthen | 49,700 | 62,000 | 69,600 | 15 | 79,800 | 15 | 92,000 | 974 | 8 | 35 | 77 | 124 | 81 | 45 | 67 | 142 |
| Carnarvon | 24,800 | 36,200 | 43,000 | 19 | 51,000 | 16 | 59,100 | 544 | 5 | 31 | 69 | 77 | 69 | 38 | 69 | 149 |
| Denbigh | 39,700 | 46,900 | 62,400 | 6 | 66,400 | 18 | 78,000 | 633 | 8 | 36 | 59 | 108 | 59 | 37 | 62 | 154 |
| Flint | 19,500 | 29,700 | 41,000 | 17 | 48,100 | 14 | 54,900 | 244 | 7 | 24 | 27 | 68 | 31 | 34 | 64 | 190 |
| Glamorgan | 49,700 | 55,200 | 74,000 | 19 | 88,000 | 18 | 103,800 | 792 | 9 | 77 | 125 | 189 | 123 | 43 | 69 | 158 |
| Merioneth | 23,800 | 30,900 | 30,500 | 5 | 32,000 | 9 | 35,100 | 663 | 6 | 23 | 34 | 45 | 34 | 43 | 67 | 163 |
| Montgomery | 27,400 | 37,000 | 49,300 | 9 | 53,700 | 14 | 61,100 | 839 | 9 | 37 | 51 | 92 | 53 | 38 | 65 | 160 |
| Pembroke | 41,300 | 44.800 | 58,200 | 8 | 62,700 | 20 | 75,500 | 610 | 7 | 67 | 141 | 158 | 139 | 47 | 83 | 159 |
| Radnor | 15,300 | 19,200 | 19,700 | 10 | 21,600 | 8 | 23,500 | 426 | 6 | 21 | 52 | 75 | 52 | 36 | 64 | 159 |
| Totals | 366,500 | 449,300 | 559,000 | 13 | 632,600 | 16 | 731,800 | 7,425 | 84 | 462 | 833 | 1,241 | 855 | 41 | 69 | 156 |

## SCOTLAND.

| SHIRES OF | POPULATION. | | | | | Number of Parishes. | Number of Population Returns, 1821. |
|---|---|---|---|---|---|---|---|
| | 1801. | Increase per cent, | 1811. | Increase per cent. | 1821. | | |
| Aberdeen | 127,200 | 10 | 139,600 | 14 | 158,500 | 82 | 93 |
| Argyll | 74,300 | 19 | 88,400 | 12 | 99,300 | 50 | 56 |
| Ayr | 87,100 | 23 | 107,400 | 21 | 129,800 | 46 | 51 |
| Banff | 37,000 | 2 | 37,900 | 17 | 44,400 | 23 | 27 |
| Berwick | 31,600 | 1 | 31,800 | 7 | 34,100 | 33 | 34 |
| Bute | 12,200 | 2 | 12,400 | 13 | 14,100 | 5 | 6 |
| Caithness | 23,400 | 4 | 24,200 | 27 | 30,800 | 10 | 10 |
| Clackmannan | 11,200 | 11 | 12,400 | 9 | 13,500 | 5 | 6 |
| Dumbarton | 21,400 | 17 | 25,000 | 11 | 27,900 | 12 | 12 |
| Dumfries | 56,400 | 15 | 65,100 | 11 | 72,300 | 43 | 45 |
| Edinburgh | 127,100 | 21 | 153,600 | 27 | 195,300 | 41 | 46 |
| Elgin | 27,600 | 5 | 29 000 | 9 | 31,800 | 20 | 23 |
| Fife | 96,900 | 8 | 104,600 | 12 | 116,800 | 61 | 76 |
| Forfar | 102,400 | 8 | 110,800 | 4 | 115,700 | 54 | 56 |
| Haddington | 31,000 | 4 | 32,200 | 11 | 35,800 | 24 | 25 |
| Inverness | 76,800 | 5 | 80,900 | 14 | 92,000 | 30 | 37 |
| Kincardine | 27,200 | 4 | 28,400 | 5 | 29,700 | 19 | 21 |
| Kinross | 6,900 | 8 | 7,500 | 6 | 7,900 | 4 | 7 |
| Kirkcudbright | 30,200 | 15 | 34,800 | 14 | 39,700 | 28 | 28 |
| Lanark | 151,600 | 31 | 198,100 | 26 | 249,300 | 50 | 51 |
| Linlithgow | 18,400 | 9 | 20,100 | 15 | 23,100 | 13 | 15 |
| Nairn | 8,500 | — | 8,500 | 8 | 9,200 | 4 | 7 |
| Orkney and Shetland | 48,400 | — | 47,700 | 14 | 54,200 | 53 | 56 |
| Peebles | 9,000 | 14 | 10,300 | — | 10,200 | 16 | 16 |
| Perth | 130,600 | 7 | 139,600 | 2 | 141,800 | 81 | 83 |
| Renfrew | 80,700 | 19 | 96,100 | 19 | 114,400 | 17 | 22 |
| Ross and Cromarty | 57,200 | 10 | 62,900 | 12 | 70,200 | 33 | 33 |
| Roxburgh | 34,800 | 11 | 38,500 | 8 | 41,700 | 32 | 34 |
| Selkirk | 5,200 | 16 | 6,100 | 11 | 6,800 | 5 | 9 |
| Stirling | 52,500 | 15 | 60.200 | 11 | 66,700 | 24 | 29 |
| Sutherland | 23,900 | 2 | 24,400 | — | 24,300 | 13 | 15 |
| Wigtown | 23,700 | 17 | 27,800 | 22 | 33,900 | 17 | 17 |
| Totals | 1,652.400 | 13 | 1,865,900 | 14½ | 2,135.300 | 948 | 1,046 |

# PORCELAIN.

Definition.

Porcelain is a term respecting the origin and meaning of which various conjectures have been formed. It is said to have been derived from the French *pour cent années,* because an absurd notion prevailed among Europeans that the materials of porcelain required to be matured under ground for a hundred years; but the most generally received opinion is that the term is derived from the Portuguese *porcellana,* a cup, because the Portuguese were the first to introduce this manufacture into Europe. Under this head we shall treat not only of the manufacture of the finest earthen ware, called China ware, from its having been first invented in China, but also describe the process of making coarse earthen ware, which, from the grossness of the materials of which they are composed, are unsusceptible of the high ornament and polish of porcelain. Indeed, the two branches may be very properly treated of under the same head, as pottery is merely the coarser species of porcelain.

*History.*—The art of making coarse earthen vessels must have been known long before so elegant and so complicated a manufacture as porcelain could have been dreamt of. It seems probable that vessels for holding meat and drink were at first made of the skins of beasts caught in the chase, or were excavated out of wood. The art of making such articles of earth, however, was no doubt invented at a very early period of society. The knowledge of pottery among the Chinese, must have paved the way for the invention of porcelain. Among the Egyptians, the manufacture of pottery was known at an early period. From them it descended to the Greeks and Romans; and to such a degree of perfection did the latter people carry the art, that in some respects it has not yet been surpassed. About the year 1686, the manufacture of pottery seems to have been in its rudest state in this country; but two brothers from Holland, of the name of Eders, or Ellers, settled in Burslem, in Staffordshire, some years afterwards, and gave a new impulse to the art, by accomplishing various improvements and discoveries. It was not, however, till the year 1763 that the most important and memorable improvements were made in the art by Josias Wedgewood, an account of whose admirable inventions and discoveries will be found in this work under the article Wedgewood. Prior to his time, the pottery of Britain was almost destitute of taste, beauty, and utility. Manufactures of earthen ware are now established in various parts of England, and what is denominated the potteries in Staffordshire is a place eight miles long and six broad, containing fifteen manufactories, of which one is *Etruria,* founded by Mr Wedgewood, and so called after the district in ancient Italy, where the art was cultivated with the greatest ardour and success.

History.

Porcelain is mentioned in the Chinese annals as an important manufacture so early as the year 442; but as it was then made of the same materials as at present, and as it had then also arrived at a degree of perfection which no subsequent skill or experience has been able to surpass, the invention must have taken place at a much earlier date. This manufacture, which is called by the Chinese *tse-ki,* is chiefly carried on at King-te-tching, a town in the province of Kiang-see, and it has also been attempted in various other parts, as at Quan-tong and Fokien. (See China.) At a very remote period, too, this art was known in Japan and some other places in the east. The knowledge of it is generally supposed to have been introduced into Europe by the Portuguese; but it is not much more than a century since porcelain was really manufactured in Britain. The first in Europe who is said to have had the merit of ascertaining the nature of porcelain manufacture, was a German chemist of the name of M. de Botticher, who pursued his experiments with indefatigable ardour, and thus fabricated, though accidentally, the first porcelain really made in the western world. After him M. Reaumur contributed very much to bring the art to perfection in Europe. The first European porcelains were made in Saxony. France soon followed the example; and manufactories of this article were soon established in England, and in all the principal countries in Europe, all of which differed from those of Japan and China, while each possessed its peculiar character. Other philosophers have since made porcelain manufacture the object of scientific investigation, especially the late Mr Wedgewood, whose name is known throughout Europe, not merely for his inventions and discoveries in the manufacture of earthen ware, but for the benefits he conferred on natural science in general.

The manufacture of porcelain has been brought to a great degree of perfection in England. In many of the essential qualities, and particularly in the beauty and richness of the paintings, as well as in the elegance of the forms, the English porcelain is little inferior to that of any other country. This manufacture was first established at Derby about the year 1750, by a Mr Duesbury, who is said to have been a very ingenious artist. After his death the manufactories received very considerable improvement, especially in the judicious methods pursued in the preparation of the paste, and increasing the beauty of the ornaments. The ware itself is said not to equal in fineness that which is manufactured in Saxony and France, although it is greatly superior in respect of decoration and workmanship. The paintings in general are rich, and executed with taste, and the gilding and burnishing are extremely beautiful. The body of the semi-vitreous kind, which is formed of a fine white clay, in combination with various proportions of different fusible matters, has obtained the name of porcelain. The best kind is wholly infusible, and is glazed with a vitreous substance which has not a single particle of lead in its composition.

Since the year 1690, various kinds of stone-ware, glazed by the fumes of salt, have been added to the wares before made. But the salt glaze, the only one formerly in use for this purpose, is in its own nature so imperfect, and the potters, from an injudicious competition among themselves for cheapness rather than excellence, had been so inattentive to elegance of form and neatness of workmanship, that this ware was rejected from the tables of persons of rank; and about the year 1760, a white ware, much more beautiful and better glazed than ours, began to be imported in considerable quantities from France. The inundation of a foreign manufacture, so much superior to any of our own, must have had very bad effects upon the potteries of this kingdom, if a new one, still more to the public taste, had not appeared soon after. In the year 1763, Josias Wedgewood, who had already introduced several improvements into this art, invented a species of earthen-ware for the table, quite new in its appearance, covered with a rich and brilliant glaze, bearing sudden alternations of heat and cold, manufactured with ease and expedition, and consequently cheap, and having every requisite for the purpose intended. To this new manufacture the queen was pleased to give her name and patronage, commanding it to be called Queen's ware, and honouring the inventor by appointing him her Majesty's potter. The common clay of the country is used for the ordinary sorts; the finer kinds are made of clay from Devonshire and Dorsetshire, chiefly from Biddeford; but the flints from the Thames are all brought rough by sea, either to Liverpool or Hull.

The most perfect pottery, particularly so far as regards excellence of workmanship, has been manufactured by the late Mr Wedgewood, and since by his sons. Among the most superb of their productions are their imitations of jasper, manufactured into vases, medallions, and other ornamental forms. The substance of which they form their mortars, and a variety of chemical utensils, is extremely hard, and is not acted upon by acids. The black and the yellow ware made by Messrs Wedgewoods, of which the late Mr Wedgewood was the inventor, possesses great elegance, and a very compact body. The black ware owes its colour to the presence of oxide of iron, and a small portion of oxide and manganese. The yellow ware, which is similar in texture, owes its colour to the presence of a little iron alone. A great number of places furnish natural products capable of assuming this yellow tint.

Besides the queen's ware invented by Mr Wedgewood, we may notice several others, which derive their origin from his experimental researches. Of these the following are the principal: 1. A terra cotta; resembling porphyry, granite, Egyptian pebble, and other beautiful stones of the siliceous or crystalline order. 2. Basaltes, or black ware; a black porcelain biscuit of nearly the same properties with the natural stone. 3. White porcelain biscuit; of a smooth wax-like appearance, of similar properties with the preceeding. 4. Jasper, a white porcelain of exquisite beauty, possessing the general properties of basaltes. 5. Bamboo, or cane-coloured biscuit porcelain, of the same nature as the white porcelain biscuit. And, 6. A porcelain biscuit remarkable for great hardness, little inferior to that of agate.

*In the manufacture of pottery* and of *porcelain*, whatever be the nature of the materials employed, the different manipulations for many vessels are essentially very similar. There are, however, certain points of difference which require to be noticed, that the reader may form a proper idea of the subject.

Most kinds of pottery are formed of a combination of clay and flint. The natural compounds, commonly called clays, consist of pure clay or alumine, combined with silex, lime, and sometimes magnesia, and frequently also with oxide of iron.

The properties of a good clay are, first, that it divide or melt in water; second, that it fall down without diminishing the transparency of the water; third, that the precipitated earth, when brought to the consistence of soft paste, possess such a degree of tenacity and ductility, that it may be wrought with the hand or on a lathe: fourth, that it retain its form and consistence on drying in the air: fifth, that it harden by the application of heat, without cracking or fusion; and, sixth, that it be capable, when baked, to resist sudden transitions of heat and cold.

The clay undergoes such preparation, at the place where it is procured, as to free it from stones and many other impurities. It is thrown into a cylinder of cast metal, four feet high, and twenty inches in diameter. In the middle of this cylinder runs a perpendicular shaft, with knives as radii at right angles to the shaft; by the revolution of the shaft, the knives do not only cut any thing in their way, but constantly force downwards what may be in the cylinder, agreeably to the nature of the screw. Another set of knives is inserted in the interior surface of the cylinder. The two sets, the one active, the other passive, have the effect of sheers in cutting the clay into small pieces, while the spiral form of the active knives forces the clay in its reduced state out at an aperture at the bottom of the cylinder, from whence it is transferred to a vat, for the purpose of mixing the clay with water. In the centre of this vat turns a perpendicular shaft, having cross arms, or radii, one below the other. These are connected by perpendicular staves, giving the moveable part the appearance of two opposite gates, upon the central shaft. These gates revolve in the cylinder just immersed in the pulp, the constant agitation mixing all the fine particles completely with water, while the stony particles of greater magnitude remain at the bottom. The pulp is now passed off from this vat through a series of sieves of different degrees of fineness, which work backward and forward by machinery: this separates the gross parts from that which is fitted to enter into the composition of the water. The flint, in its crude state, is the common flint used for striking fire, which principally consists of pure silex. It is first placed in a kiln, and heated to a red heat, and while red hot thrown into cold water. This process is meant to lessen its aggregation and make it easier to reduce to powder. The pieces are laid upon a strong grating, so that as they become of a certain size, they are driven through the divisions of the grate. After this process, they

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are taken to a mill, which consists of a cylindrical pan, similar to that used for mixing the clay with water, but the arms of the upright shaft are made to carry large stones of great hardness: the stone is known by the name of *chert*. These stones are fastened to the arms of the upright shaft, so that the under side, which is perfectly flat, may move over similar passive stones. This cylindrical pan contains a certain quantity of water, when the small masses of flint are introduced. The flint soon gets between the chert surfaces, which, from their great hardness, reduce the flint to a pulpy consistence. The finer particles become suspended in the fluid, and are run off from time to time near the top of the pan. This pulp is then passed through lawn or silk sieves in a similar manner to the clay, the part which remains in the sieve being returned to the mill to be ground over again.

When the flint and clay, in their pulpy state, have been intimately mixed, the next process is to separate the excess of water, which is effected by evaporation. The vessel in which the pulp is placed for evaporation should expose a great surface, its breadth being about five or six feet, its length twenty to thirty, and very shallow. The bottom is made of fire-bricks, and the flame of the fire, which is at one end of the brick-work, passes along a flue under the bottom. When the evaporation has been continued till the mass is sufficiently stiff, it is cut out in cubical masses, and is next subjected to a process, by which the mass is rendered of uniform stiffness throughout, and fit for working. The operations, by which this effect is facilitated, are by hand, or by a machine for the purpose. The first, called sloping or wedging, consists in taking a mass of clay in both hands, and with a twist of both at the same time, the piece is separated into two pieces. They are now brought together with greater violence, but in different parts to those just separated. The piece is now separated at right angles, and two new surfaces brought in contact. This change of surface every time, sometimes twenty or thirty times, effects the uniform mixture of the different parts so completely, that if, at the commencement of the operation, the mass consisted of two distinct pieces, one black, and the other white, at the end of the operation the mass would become of an uniform grey colour. This change is also effected with more dispatch by a machine very similar to that first used for cutting the crude clay into pieces.

With every precaution that can be observed in the preparation of the materials for the finer kinds of porcelain, it is still necessary to subject it to another operation; the object of which is, to divide minutely, thoroughly mix, and give the whole mass a uniform consistence. By the workmen, this process is called *dressing the earth*; it is performed by mixing and kneading the mass with the hands, or by beating it upon tables with large round pieces of wood.

The manufacture of porcelain was, as we have already hinted, carefully investigated by M. Reaumur. He demonstrated, by experiment, that in the fabrication of the porcelain of China, two ingredients are essentially necessary. Both these ingredients, namely, the *petuntse* and the *kaolin*, were, by this eminent philosopher, chemically examined. Having exposed them to an intense heat, he found that the former had melted without addition, and that the latter had manifested no signs of fusibility. Reaumur afterwards mixed both these substances together, forming the mass into cakes; and having baked them, they were observed to resemble the Chinese porcelain. The mixture of the *kaolin* and *petuntse*, in proper proportions, furnishes a semi-vitrifying material, which is necessary for the production of the finer kinds of porcelain; and as these ingredients are rarely found in nature in those proportions which are suitable to the manufacture, the two are separately prepared.

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The paste being prepared, the desired *form* is given to it, either by the labour of the hands, by means of moulds, or by the lathe; and the selection of one or other of these methods, it is obvious, must be regulated by the nature, size, and form of the works to be executed. All kinds of sculpture, busts, and other ornaments, are made with the hand; common bricks, tyles, and other works, which are not exactly cylindrical, are formed in moulds; but all vessels of a round shape, or which are hollow, are wrought with the lathe; and when a more perfect finishing is required for any piece of work, it is again subjected to the operation of the lathe after having dried a little, that its forms may be rendered more delicate by means of sharp steel instruments.

In the *baking* of pottery and porcelain, the furnace employed varies in its construction according to the nature of the work; but, in general, the furnace is a round or square tower, the interior of which presents two distinct parts separated by an arch, in which are several openings to allow a passage to the flame. In baking or firing coarse earthen ware, any kind of fuel may be employed; but that which yields the most copious flame is generally preferred. More attention is requisite in the baking of porcelain and fine earthen wares. Every separate piece is enclosed in a case or frame called a *seggar*, which is formed of a very porous paste, that it may resist unchanged the action of the heat. The pieces thus enclosed are prevented from running or adhering to each other, and any alteration that exposure to the smoke might induce is precluded. The baking of porcelain usually requires from 36 to 48 hours. The progress of the operation is discovered by means of proof-pieces, as they are called, that is, pieces formed of the same materials, placed in convenient situations in the furnace, and which may be withdrawn and examined from time to time.

Porcelain, which has been subjected to the process of baking or firing, is said to be in the state of *biscuit*; and for many purposes, various works of pottery or earthen ware require no other process; but those productions of the pottery which are in the state of biscuit, from their porous nature, are unfit for holding liquids, and therefore require some covering, to prevent the liquors which they are destined to receive from penetrating into their substance. For this purpose, a vitreous coating is spread over the surface. When the vitreous coating is applied to coarse earthen ware, it is called varnish or

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glazing; and for this purpose, the oxides of lead, as minium or litharge, and the sulphuret of lead or galena, hence known by the name of *potter's ore*, are employed. But whatever be the nature of the varnish, it is not used till it is reduced to an impalpable powder, so that it may remain some time suspended in water. The pieces to be varnished, after being dried in the shade till they have acquired the necessary degree of consistence, are immersed in the water, which holds suspended in it a fat earth in a state of very minute division, and previously passed through a silk sieve; the pieces are then hastily drawn out covered in the operation by a slight coat of this earth. The colour of the earth is the ground of the colour of the ware; and if a green colour be required, it may be communicated by the addition of some copper filings. On this coat of fat earth, the sulphuret of lead is applied almost always mixed with equal parts of sand, reduced to the state of the finest powder, and suspended in water. In this way, the shades of colour of the ware may be varied at pleasure, by applying separately, on the different parts of the surface, the fat yellow, white, or red earths, and mixed or not with copper filings.

In some potteries, the varnish is not applied till the ware has been subjected to one firing. In this case, less varnish is requisite, but more workmanship, and a greater consumption of fuel is necessary for the second firing; and hence the artist must take into consideration the advantages and inconveniences of the two methods in different circumstances. A black vitreous colour is communicated to earthen ware, by projecting into the fire, at the time of its utmost intensity of heat, a quantity of coal in the state of powder or dust. The draught of the fire being thus checked, the furnace is filled with a dense smoke, which, being deposited upon the ware, forms a coating, which is vitrified as soon as the current of air rekindles the fire, and restores the heat. An incipient vitrification is also produced by throwing common sea-salt upon a well-heated fire; for the salt is volatilized, and attaches itself in part to the softened surfaces of the earthen ware: but it must be observed, that the methods now mentioned can only be employed when the fire is very strong, and when the ware can bear a sudden change of temperature without cracking or melting.

For common earthen ware, no glazing could be discovered that is free from objection, without the use of lead, which, on account of its poisonous quality, should, if possible, be avoided. To find a substitute for lead was consequently a desideratum in this branch of manufacture. With this view, Chaptal reduced pieces of clear broken glass to a very fine powder, and with this powder sprinkled the surface of the earthen ware, previously covered with a weak coat of fat clay; or the glass powder may be mixed with fat clay, and the whole being diluted in water, the dried pieces are plunged into the mixture, and thus receive a covering of varnish, which is quite safe, very economical, and requires less heat for its vitrification. Some volcanic products, such as lava, have been suggested, and employed as a varnish for earthen ware, and in some cases have been found to answer pretty well.

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A black glaze is communicated to a peculiar kind of ware which is manufactured at Nottingham. The composition of this glaze is one part of oxide of manganese, seven parts of white lead, and nearly two parts of flints; and on that kind of pottery it produces a very fine effect.

The different substances now mentioned for covering pottery-ware, are in a vitrified state, and exhibit nothing of the metallic appearance. By a late invention, a metallic gloss is communicated to porcelain, and from its colour has received the appellation of gold and silver lustre. The metallic substances employed for giving this lustre to porcelain are gold and platina; but before the application of the metal, the ware must be previously glazed; and when it is intended to apply the gold lustre, the porcelain is made of a red or brown clay, which, after being baked and glazed, exhibits its colour through the thin covering of gold, and thus produces the delicate brown shade for which this kind of porcelain is distinguished. The oxide of the metal is mixed up with an essential oil, and in this state is applied to the ware by means of a brush. The porcelain being placed in the enamelling furnace, the oxide is deprived of its oxygen by means of the carbone of the vegetable matter, aided by the heat, and it then exhibits the metallic lustre. When the covering is composed of platina, it produces what is called the silver lustre; but from some diversity in the state of the metal, the colour has sometimes the lustre of silver, and sometimes it approaches more nearly to that of iron or steel.

The *colouring matters* which are applied to pottery and porcelain are derived from the metallic oxides. Iron produces various shades of red, brown, and black, and the intensity of the latter is greatly increased by the addition of a small portion of copper; antimony or silver furnishes a yellow or orange colour, and for this purpose it is calcined with four times its weight of nitre, and then mixed with vitrified lead; gold in the state of purple precipitate of Cassius affords violet and purple colours; copper gives greens; and cobalt, the oxide of which is generally prepared from zaffre, communicates a fine blue colour.

The colouring matters which are employed in the porcelain manufacture are applied in two ways, either by the hand or by means of a printed impression of the design taken on paper. In painting on porcelain, if the ware be in a state of biscuit, the metallic is mixed up with water, and brought to that state of dilution which renders its application easy by means of the pencil. The ware thus painted is glazed, and is subjected to a single baking only, but in certain cases the painting is executed upon the glaze; for some colouring matters would be injured or destroyed if subjected to the heat of the gloss oven. As the effect of painting on porcelain depends on the taste and execution of the artist, the English and French wares greatly surpass in this department of the manufacture the most splendid productions of the east. For the purpose of communicating designs to porcelain, by means of an impression taken on paper, the colouring matter is mixed up with boiled lintseed oil; the design is engraved on a copperplate, to which the colouring matter is applied in the usual way; and a sheet of thin paper, called silver-paper, being laid upon the plate, it is passed through the rolling press; and while it is yet wet, the paper, with the impression after the superfluous parts are cut off, is applied to the ware in the state of biscuit, and is rubbed hard with a piece of flannel rolled up, that the colouring matter may be forced into its pores. After the paper has remained for about an hour, to allow a sufficient quantity of the colouring matter to be absorbed, it is separated by immersing the ware in water; the paper becomes soft, and is easily removed by slight friction, and a distinct impression of the design remains on the biscuit. The porcelain having in this manner received the impression, is allowed to stand till it become sufficiently dry, when it is introduced into a furnace at a low heat for the purpose of expelling the oil, while the more fixed metallic matter remains, and it is then ready for the operation of glazing. As the oxide of cobalt is extensively employed in this country for communicating a blue colour to earthen ware, this process is known among workmen by the name of *blue printing*; and it is a curious fact that the method of preparing this colouring matter has reached such a degree of perfection in England, that the Chinese potters are supplied with it from this country.

For preparing gold, which is to be employed in gilding porcelain, the metal is dissolved in nitro-muriatic acid; and the acid being driven off by heat, the gold which remains behind, and has returned to the metallic state, is mixed with borax and gum water, which forms a convenient vehicle for fixing it upon the ware; it is then baked in the furnace, and the metal resumes its metallic lustre by burnishing. In this process, it is obvious that the vegetable matter, the gum, is burnt off, and the borax forms a vitrifying cement, which unites the gold strongly to the ware.

See *Mémoires de l'Académie des Sciences,* 1727-1729; *Swedish Transactions,* 1753; *Mem. de l'Acad. des Sciences,* 1765; Macquer's *Chemical Dictionary*; Nicholson's *Journal,* Vols. III. and XII.; *Philosophical Magazine,* Vol. III.; *Annals of Philosophy,* Vol. III.; and Murray's *System of Chemistry,* Vol. III.

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Porcelain Earth, a mineral substance, called by the Chinese *kaolin*, which, when pure, is infusible; and the colour of it is either pure white or verges on a yellow or flesh red. Its constituents are stated to be 52 parts silica, 47 alumina, 33 oxide of iron, and most kinds in their recent state contain a portion of water. The specific gravity of this mineral is 2.2.

The *porcelain of Reaumur*, as it is called, is formed of common bottle glass, and appears of a milky colour, semi-transparent, of a fibrous grain, and infusible. To transform glass into porcelain, the vessel which is to undergo the process must be inclosed in a baked earthen case or seggar; both must be filled with a cement formed of equal parts of sand and powdered gypsum, and the whole put into a potter's kiln, where it is to remain during the time that is required for baking the common earthen-ware.

PORCH, a sort of vestibule supported by columns, much used at the entrance of the ancient temples, halls, churches, and other edifices. See Architecture.

PORES, the small interstices in bodies, between their solid component particles. There is reason to believe, that all bodies with which we are acquainted have pores. Gold, for instance, presents not the slightest impediment to the transmission of the magnetic effluvia; it also admits quicksilver into its pores, and even water can be forced through them. This was proved by the well known experiment of the Florentine academicians, who, in order to try whether water was compressible or not, filled a concave sphere of gold with water, and soldered it up in the closest possible manner. Having then compressed it with immense force, they found upon examination that the water had been forced through the pores of the gold, and was standing like drops of dew on the surface of the sphere without any crack or flaw having been produced in the metal. The ready passage of the magnetic and electric effluvia through certain bodies, as also that of light through glass and other transparent substances, has been referred to the same cause.

PORISM, or Porisma, in geometry, a name given to two sorts of mathematical propositions. It is a kind of theorem in form of a corollary, which depends upon some other already demonstrated, and it has been variously defined. Proclus calls it a theorem drawn occasionally from some other theorem already proved. Pappus describes "a porism as that in which something is proposed to be investigated." There are other definitions of it, by different geometricians: But Dr Robert Simpson, considering all the previous ones as either defective or erroneous, has given a more general definition of a porism, which, according to him, is "a proposition either in the form of a problem or a theorem, in which it is proposed either to investigate or demonstrate." Mr Playfair has also given a definition of this word. "A porism," says he, "is a proposition affirming the possibility of finding such conditions as will render a certain problem indeterminate, or capable of innumerable solutions." Euclid applied this name to propositions which are involved in others, which he is professedly investigating, and which are thus obtained in the research without intending it, and are, therefore, termed porismata, *acquisitions.* It may be laid down as a general principle, that a problem is converted into a porism when one or when two of the conditions of it necessarily involve in them some one of the rest. If, in the hypothesis of a problem, the conditions be so related to one another as to render it indeterminate, a porism is produced. In some cases a porism may be so simple as to arise merely from the coincidence of one condition with another, although no inconsistency whatever in any case may be produced between them.

The author of the Elements wrote three books of porisms, which are now lost; and from some scanty materials supplied by Pappus, modern geometricians have attempted to supply, either completely or in part, what the ancients are supposed to have known on this subject.

Among the moderns, Dr Simson composed a useful treatise on this subject, which was afterwards published at the expense of a very able mathematician, the Earl of Stanhope, who was the liberal patron of several individuals who had improved this branch of science. Dr Simson's ardour and perseverance, in elucidating this obscure subject, was at length fully rewarded; but if any obscurity still remained, as to the origin of this class of propositions, it has since his time been completely removed by the philosophical account that has been given of it by Mr Playfair. In the life of Simson published by Dr Trail, there is the following account of the cause of his discovery, as may be seen in the Transactions of the Royal Society of Edinburgh, Vol. III. "Dr Simson," says his biographer, "maintained for sometime his resolution of abstaining from all attempts at the rediscovery of porisms; but happening one day to be walking with some friends on the banks of the river Clyde at Glasgow, and by accident being left behind his company, he inadvertently fell into a reverie respecting porisms. Some new ideas struck his mind, and with his chalk having drawn some lines on an adjoining tree, at that moment, for the first time, he acquired a just notion of one of Euclid's porisms."

In their investigations the ancients were not in the practice of employing algebra, although algebraical analyses, as well as geometrical, belong to porisms. Those who may wish to prosecute this subject will find much valuable information in Dr Simson's excellent treatise *De Porismatibus* in his *Opera Reliqua*; also in Dr Stewart's *General Theorems*, in which are to be found many beautiful porisms without illustrations. In the fourth volume of the Transactions of the Royal Society of Edinburgh, there is a valuable treatise on the same subject by Mr Wallace, of the Royal Military College, under the title of "*Some Geometrical Porisms, with Examples of their Application to the Solution of Problems.*"

**PORPHYRIUS**, or **Porphyry**, a celebrated Platonic philosopher, and an inveterate enemy to the Christian faith, was born at Tyre, A. D. 233. He studied when very young under the Christian father Origen; afterwards he became a pupil of Longinus, and about the 30th year of his age began to attend the instructions of Plotinus at Rome, with whom he lived six years, during which he made great progress in literature, geography, astronomy, and music.—His treatises against Christianity are lost, and are said to have been partly destroyed in consequence of orders issued by Constantine. All the knowledge that we now possess of them is gleaned from extracts preserved in the Christian fathers. His works, with a Latin version, were printed at Cambridge, 8vo. 1655.

**PORPHYRY**, a compound rock, consisting of crystals of feltspar or quartz, generally the former, imbedded in some other substance, commonly one allied to trap; and from the stone in which the crystals are found, the various kinds of porphyry are denominated, as horn-stone porphyry, clay-stone porphyry, obsidian porphyry, &c.

Immense strata of porphyry exist in Egypt. The hard red lead-coloured porphyry, variegated with white, black, and green, is found in the island of Minorca. It is superior to the Italian marbles, is as hard as the oriental porphyry, and in beauty and variety of colour is said even to surpass them.

The moderns view with surprise the works executed in porphyry left by the ancients, and are at a great loss to discover with what tools they contrived to cut it, for modern ones will hardly touch it. In the year 1555, Cosmo de Medicis is said to have distilled a water from certain herbs, with which his sculptor, Francesco Tadda, gave his tools such an admirable hardness, and so fine a temper, that he performed some exquisite works with them; particularly our Saviour's head in demi-relievo and the heads of Cosmo and his duchess. The very hair and beard, how difficult soever, are well executed, and there is nothing of the kind superior in all the works of the ancients; but the secret seems to have died with the discoverer. Various methods have been tried to cut porphyry, and to give tools the necessary temper, but with no great success. Goats' blood is said to have produced the finest temper; but in working with chissels, even when tempered with it, sparks of fire came much more plentifully than pieces of the stone. The French have discovered another mode of cutting this hard and untractable substance, namely, with an iron saw without teeth, and grez, a kind of free-stone pulverised, and water. And Mr Boyle says, that he caused it to be cut with emery, steel-saws, and water. Da Costa supposes, and perhaps with reason, that the method used by the ancients in cutting and engraving porphyry was extremely simple, and that it was performed without the aid of any scientific means, but merely by unwearied diligence, and with numbers of common tools, at great expense. See Geology, Vol. III.

**PORSON, Richard**, the greatest Greek scholar of his age, was born on the 25th December 1759, in the parish of East Ruston in Norfolk. His father, who was clerk of the parish, taught him, while very young, all the common rules of arithmetic, without the use of either slate or book, and this exercise is supposed to have had no small share in the attainment of that habit of intense thought and close application, for which he was remarkable. After having attended private schools, he was, in 1774, sent to Eton, where he greatly distinguished himself. About the close of the year 1777, he was entered at Trinity college, Cambridge. Here, with the prospect of a scholarship, he devoted himself to the study of the classics, and his ability, seconded by his diligence, secured his object, for he gained the medal, and was elected fellow in 1781. In 1783 he took his degree of master of arts, and in 1791 was elected Greek professor at Cambridge.

Of his academic visit to the continent, Professor Porson has given the following account:

"I went to Frankfort, and got drunk
With that most learned professor, Brunk;
I went to Worts, and got more drunken
With that most learned professor, Ruhnken."

In 1794 he married an amiable lady, who died three years afterwards. On the establishment of the London Institution, he was chosen principal librarian, an office which he did not long enjoy, for in September 1808 he was seized with a fever, which soon terminated fatally. The works of this eminent scholar are too well known to the learned world to stand in need of enumeration; but his principal writings are, Letters to Archdeacon Travis, in answer to his Defence of the three heavenly witnesses, his *Hecuba*, *Orestes*, and *Medea* of Euripides, which were published in London 1822, and his MSS. of Photius's Lexicon, which the same year appeared at Cambridge.

PORT, in sea affairs, the larboard or left side of a ship. Thus a ship is said to have a heel to port when she inclines towards the left side.

PORT-GLASGOW. See RENFREWSHIRE, and Clelland's *Annals of Glasgow*, published 1816.

PORT-JACKSON. See HOLLAND, NEW.

PORT-LOUIS, a sea-port and principal town of Mauritius, situated on the west side of that island in a valley surrounded with high mountains. Also a town of France, in the department of the Morbihan, seated at the mouth of the river Blavet.

PORT-MAHON, a sea-port town in the island of Minorca, of which it is the present capital, is situated on the left bank of the port, on entering from the sea, which it commands. The port is reckoned one of the finest, safest, and most convenient in the Mediterranean. See MINORCA.

PORT-PATRICK, a small burgh and sea-port of Scotland, about 20 miles distant from Donaghadee, on the west coast of Wigtonshire, which has derived its name from the tutelary Saint of Ireland. Its exposure is to the south-west, on which side it is confined by the sea, and on the other by the overhanging rocks and hills. Near the centre of this romantic semicircle, a small stream flows on the north side of the town, and empties itself into the sea. The principal street runs parallel with the bay, and connected with it are several smaller ones at right angles leading towards the mountains. The church is of great antiquity, having been erected in 1628; and the houses are substantially built, covered with slate, and extremely comfortable. It has risen to its present importance merely in consequence of its official communication with Ireland, and since the beginning of last century its inhabitants have increased from one hundred to about one thousand. It is remarkable for its excellent harbour and its ferry to Donaghadee, from which it is only about 21 miles distant. In 1662 a mail was established, and likewise a packet-boat, for conveying it between the two kingdoms, which, by an act of Parliament, was fixed to go weekly. The object of this act, however, being defeated, the established packet was abolished, and a premium was given to whatever vessel should first sail after the arrival of the mail, but the communication between the two kingdoms increasing, no boat would proceed immediately to sail without an additional cargo; and so great is the intercourse at the present day, that packet-boats, fitted up for passengers and the mail, cross daily, and each of these boats, four in number, are now in receipt of L.800 a year from government. A customhouse has been established at Port-Patrick, as well as a quay, and a reflecting light-house. In consequence of the late improvements, which are calculated to have cost about L.150,000, the harbour is much extended, and more accessible; so that the new line of road, together with the establishment of a steam-boat, will be extremely beneficial to those who have occasion to travel frequently between the two kingdoms.

Although, in consequence of the vast communication that takes place between Great Britain and Ireland, almost every house in Port-Patrick is an inn, yet the inhabitants are in general sober and industrious. The chief articles imported are black cattle, of which upwards of 12,000, besides several thousand horses, are computed to be yearly imported at this place. Rain is more frequent here than in the interior, during the west wind, which is the most prevalent. The atmosphere for the most part is pure, and the climate mild, chiefly owing perhaps to the cold winds being intercepted by the surrounding mountains. See WIGTONSHIRE; also Dr M'Kenzie's *Statistical Account*, Forsyth's *Beauties of Scotland*, and Chalmers' *Caledonia*.

PORT-ROYAL, a sea-port in the island of Jamaica. It was at one time one of the richest and most important places in the West Indies; but in 1692 it was destroyed by an earthquake, in 1702 by fire, and in 1722 by an inundation of the sea, and in 1744 it suffered greatly by a hurricane. In consequence of these calamities it is now greatly reduced, both in size and importance, the custom-house and other public edifices having been removed. The harbour is deep and capacious.

PORT-ROYAL, an island of North America, on the coast of South Carolina. With the neighbouring continent, it forms one of the most commodious harbours in the British plantations. It is 15 miles in length, and has a town on the north shore called Beaufort. W. long. 80., N. lat. 31.

PORTARLINGTON,—see QUEEN'S COUNTY.

PORTCULLICE, or PORTCULLIS, in fortification, a machine formed of strong pieces of timber framed together, and joined across one another like a lattice or harrow, the lower ends of the upright pieces being pointed and shod with iron. This machine, which is let down and drawn up by ropes or chains attached to a windlass, is suspended over the gates of fortified places, in order to stop up the gateway on the sudden approach of an enemy. See WAR.

PORTA BAPTISTA, a Neapolitan philosopher, born about the year 1545, and died in 1615. He ardently applied himself to the study of nature; and for the advancement of knowledge an academy was established in his house, to which none was admitted but such as had made some useful discovery, or communicated some new information. His great work, the *Magia Naturalis*, appeared about the year 1560, and was soon translated into Italian, French, Spanish, and Arabic. It contains all the curiosities in nature and art which were known in his time, and also a description of the camera obscura. In the pursuit of knowledge, Baptista Porta travelled through Italy, from which he went into France and Spain, visiting all the public libraries and learned men. He had the honour of being a member of the Academy de Lyncaei, and of enjoying the friendship of the celebrated Francis Paoli at Rome. See OPTICS.

PORTER, a kind of malt liquor, which differs from ale and pale beer, being made with high dried malt. The origin of porter is thus related by the editor of the Picture of London. "Before the year 1730, the malt liquors in general use in London were ale, beer, and twopenny; and it was customary for the drinkers of malt liquor to call for a pint or tankard of half and half, that is, a half of ale and half of beer, a half of ale and half of two penny, or half of beer and half of twopenny. In course of time it also became the practice to call for a pint or tankard of three threads, meaning a third of ale, beer, and twopenny; and thus the publican had the trouble to go to three casks and turn three cocks, for a pint of liquor. To avoid this inconvenience and waste, a brewer of the name of Harwood conceived the idea of making a liquor which should partake of the same united flavours of ale, beer, and twopenny; he did so, and succeeded, calling it entire, or entire butt, meaning that it was drawn entirely from one cask or butt; and as it was a very hearty and nourishing liquor, it was very suitable for porters and other working people; hence it obtained the name of porter." See BREWING.

PORTEUS, BEILBY, a distinguished prelate of the church of England, was born at York in 1731. His parents, who were natives of Virginia, had come over to this country in 1720 for the sake of obtaining suitable education for their family. Beilby, after receiving an introductory education in the country, was, when of a proper age, entered at Christ's college, Cambridge. In 1752 he was admitted to the degree of bachelor of arts, and in the same year was elected fellow of his college. In 1754 he was nominated one of the esquire beadles of the university, an office which he retained nearly two years, when he endeavoured to improve his narrow income by private teaching. Having taken his degree of master of arts, he was ordained deacon in the year 1755, and soon after was appointed lecturer at Whitehall. His first publication was a prize poem, on death, which met with considerable applause. In 1761 he preached a sermon before the university of Cambridge on the character of David king of Israel. This sermon, which he published, gained him the patronage of Secker, archbishop of Canterbury, and thus proved a great means of his future advancement. Having been appointed one of his lordship's domestic chaplains, he soon after this event received several valuable presentations. On the death of the archbishop he was engaged in the publication of an edition of his works, and wrote the memoir prefixed to them. The reputation he had now acquired introduced him to the notice of the queen, and upon her recommendation he was, in 1769, appointed chaplain to his majesty, and not long after was admitted master of the hospital of St Cross, near Winchester, dean of the chapel-royal, and provincial dean of Canterbury. By his successful exertions to introduce a strict observance of a fast on Good Friday, he so pleased the queen, that through her influence he was speedily raised to the bishopric of Chester. Of the bill passed in Parliament for the relief of dissenting ministers and schoolmasters, he declared that it was "a measure no less consonant to the principles of sound policy than to the genuine spirit of the gospel." Upon the death of Bishop Lowth, Dr Porteus was translated from the see of Chester to that of London. Some years after this he published his valuable Summary of the Principal Evidences of the Truth and Divine Origin of the Christian Revelation, designed chiefly for the use of young persons. In 1808, this worthy prelate died at the age of seventy-eight. In private life he was mild and affable, of irreproachable morals, a cheerful disposition, and benevolent heart. As a preacher, his eloquence was truly pleasing, his manner serious and impressive, his language elegant and chaste.

PORTGREVE, or PORTGRAVE, was anciently the principal magistrate in ports and other maritime towns. Camden observes, that the chief magistrate of London was formerly called portgreve; instead of whom, Richard I. ordained two bailiffs, and soon after King John granted them a mayor for their yearly magistrate.

PORTICI, a small town of Italy, near Naples, situated at the foot of Mount Vesuvius, the chief ornament of which town is a royal palace. Beneath it lies buried, at the depth of 70 feet, the city of Herculaneum. Portici has a population of about 5000.

PORTICO, or PIAZZA, a kind of gallery raised upon arches over a pavement where people may walk under cover. See ARCHITECTURE.

PORTLAND ISLE, an island, or rather a peninsula, in Dorsetshire, nearly opposite to Weymouth. It is connected with the mainland by the Chesil Bank, one of the most extraordinary ridges of pebbles in Europe, and perhaps the longest except that of Memel in Polish Prussia, being about seventeen miles in length, and in most places a quarter of a mile in breadth, a narrow arm of the sea, called the Fleet, interposing between it and the southern coast of England. This peninsula is famous in history, as being the scene of several memorable transactions in the military annals of England. Portland castle, a fortress of great strength, which completely commands Weymouth road, was erected by Henry VIII. Portland isle extends about four miles and a half in length, and two in breadth; it constitutes only one parish, but contains several small villages. Most of the husbandry concerns are managed by the women, the men being chiefly engaged in the quarries, which produce the celebrated Portland free-stone, first brought into repute in the reign of James I., who used it by the advice of his architects in the construction of the banqueting house at Whitehall, since which time it has been employed in the erection of almost all the public buildings of note in the metropolis. A strange custom, called the Portland custom, has prevailed here time immemorial. The women never marry till they have become pregnant by their intended husbands. Should this not happen after a limited period of cohabitation, the parties are supposed not to have been destined for each other by Providence, and the match is consequently broken off, without any imputation on the character of the female, whom the circumstance does not prevent from captivating another suitor.

PORTLAND-STONE, a compact sand-stone, united by a calcareous cement, much used in building churches, bridges, &c.

PORTLAND VASE, a splendid funeral vase, so called because purchased by the Duke of Portland for 1000 guineas, after it had long been in the possession of the family of the Barberini. The broadest part of its diameter is six inches, and its height is nearly ten. It is supposed to have been the production of some eminent artist several centuries before the Christian era, when sculpture had reached its highest excellence. The figures with which it is embellished are in bas-relief, of white opake glass, upon a ground of deep blue, which has the appearance of black till it be held up against the light. These figures are all of the most exquisite workmanship, and appear to have been produced by the labour of many years.

Numerous opinions have been formed respecting the purpose of this vase, some conjecturing it to be a representation of the Eleusinian mysteries, and others that it was merely intended for depositing the ashes of some particular person deceased. In one compartment there is a female in a reclining altitude seemingly about to expire, having an inverted torch in her left hand, supported upon her elbow as she is sinking down, whilst her right hand is elevated over her head. On her right is the figure of a man, on her left that of a woman, both seemingly in deep and serious thought, looking back to the dying figure as they appear to leave her. In another compartment is a figure descending through a portal, and received by a beautiful female, close to whom is a large and playful serpent, and an aged figure with his chin resting upon his hand. On the bottom is another figure on a larger scale with its finger pointing to its mouth, having on its head a Phrygian cap, and overshadowed by the foliage of a tree. Of the story which these figures represent nothing that can be relied upon has ever been ascertained.

PORTO-BELLO, a sea-port town of North America, on the coast of the isthmus of Darien, situated on the declivity of a mountain which surrounds the whole harbour. This harbour, discovered by Columbus, was by him, on account of its excellence called Porto-Bello, a name which has since been applied to the town. Its situation on the isthmus between the North and South seas, its distance from Panama, and its commodious harbour, give it the preference to all other places for the rendezvous of the joint commerce of Spain and Peru at the time of its fair. See America.

PORTO-RICO, an island in the West Indies, about 60 miles east of Hispaniola, extends about 140 miles in length and 36 in breadth, and is well watered and highly fertile. Great quantities of cattle are fed in the rich meadows, and the woods abound with parrots, wild pigeons, and other fowls. The trade consists chiefly in hides, tobacco, ginger, mastich, sugar, cotton, silk, oranges, and lemons. This island was discovered in 1493 by Columbus, and it attracted the notice of the Spaniards in 1509. The capital, which bears the name of St Juan de Porto-Rico, was founded in the year 1514. It is populous and well built, and has a good harbour, defended by a citadel and castle.

PORTRAIT. See Design.

PORTREE, a small town in the island of Sky, one of the Scotch Hebrides, containing a church, with an excellent bay and a good harbour for ships of any size. It obtained its name from the circumstance of James V. of Scotland having landed here in 1535, to make the tour of the Western Isles. The surrounding country is fertile in grain, and productive of cattle, and although mountainous is well inhabited. Of late years the town of Portree has been greatly improved.

PORTSMOUTH, a large sea-port and borough town of Hampshire. See Hampshire.

PORTSMOUTH, the largest town in the state of New Hampshire in North America. See Hampshire, New.

PORTSOY, a sea-port town, on a small promontory on the south side of Murray frith, in Scotland, about 170 miles north of Edinburgh, and seven from Banff. Stockings and sewing-thread are manufactured here for the London and Nottingham markets; but its principal trade is fishing. Feldspar, nearly as brilliant as the Labrador spar, is found here, and also a granite of a flesh colour, to be obtained no where else in Europe. In the neighbourhood there is a stratum of marble of a dark-greenish colour, in which it is said the curious substance called asbestos has been found. From this remarkable substance a kind of incombustible cloth is made, which is purified by being thrown into the fire.

PORTUGAL, the most westerly kingdom of Europe about 360 miles in length and 120 in breadth, is bounded on the north and east by Spain, and on the west and south by the Atlantic ocean. It is divided into six provinces; 1. Entre Douro e Minho; 2. Tra-los-Montes; 3. Beira; 4. Estremadura; 5. Alentejo; 6. Algarve. The two first lie towards the north, the two second are in the centre, and the two last towards the south.

The *name* of this country was anciently Lusitania, but the boundaries were very different from those of modern Portugal. This latter name, which first occurs in a writing dated 1069, is derived from an ancient town called *Calle*, or *Porto Calle*, which stood near the place where Oporto now stands, Portugal being a corruption of Porto Calle, or the Port of Calle. But there is another tradition, which says that a great number of Gauls came at one time hither, and landed at Oporto, on which account it obtained the name of *Portus Gallorum*, shortened afterwards into Portugal, its present appellation.

The *climate* of Portugal varies considerably in different districts. In the north it is comparatively cold, but in the south the heat, which would otherwise be scorching, is moderated by the western breeze of the Atlantic. In the centre districts, and in the vallies, which are numerous and extensive, the air is extremely mild and temperate, and although Spain and Portugal are in the same climate, yet the air of the latter is much more temperate and genial than that of the former, on account of its neighbourhood to the sea. Excepting on the summit of the mountains, snow is seldom seen; but in winter the rain is often so sudden and so great, that rivers nearly dried up will, in the course of a few hours, overflow their banks in every direction. The medium heat is about 60 degrees, and the days of settled rain in the course of a year seldom exceed 80.

*The soil* of this kingdom, in many of the extensive vallies, is a deep loam, but in the more elevated situations it is in general light, and if well cultivated would be extremely productive; but for centuries past there is perhaps no country inhabited by a people so refined and intelligent, and enjoying so many natural advantages, in which agriculture has been so entirely neglected; and hence the inhabitants, who had formerly abundance of corn, not only for their own supply but also for exportation, now feel themselves under the necessity of importing Indian corn from other countries for their own consumption. But although the inhabitants are not attentive to husbandry, yet they have plenty of olives, and their vineyards generally supply them abundantly with wine, oil, figs, pomegranates, raisins, and other fruits.

*The inhabitants* of Portugal are naturally of an indolent disposition, but so fond of luxury, that they spend all their wealth in the purchase of foreign merchandise. In person they are not so tall as those of Spain, neither are they so well proportioned. The women are in general thin, and of small stature, their complexion is olive, and their eyes dark and expressive. In their habits they are extremely retired, amiable, chaste, and domestic. Of a sprightly disposition and graceful carriage, they are peculiarly pleasing and captivating in their manners; and no women can be less ambitious of enhancing their attractions by artificial means. In dress the men imitate the French, and the ladies the manners of the East, by sitting on the floor on cushions. In the large towns they are noted for insincerity, ingratitude, and depravity, and in the smaller they are candid, polite, and industrious, and, although retired in their habits, are remarkably kind and hospitable to strangers. For their nobility they entertain a high respect, and are uniformly guided by a blind reverence for their priests, and loyalty for their sovereign.

The national religion is the Roman catholic, and no other is permitted here unless by connivance. The Inquisition, which was established about the middle of the 16th century, and which was some time ago abolished, has been again resumed. By this means the spirit of literary improvement has been so long and so effectually checked, that, although they have three universities, the education of even the higher ranks is so much neglected that they are scarcely known as a literary people, their reputation in this way depending chiefly upon the poem of the Lusiad. The clergy are extremely numerous, for, although Portugal does not much exceed Scotland in extent, the clergy amount to upwards of 4000, who as a body are not only extremely poor but extremely ignorant. Of secular clergy there are not fewer than 22,000. The convents are computed to contain 10,000 nuns, and the monasteries 14,000 monks. The archbishop of Lisbon is a cardinal, and besides being chaplain to his majesty, is dignified with the title of patriarch. There is likewise another archbishop, and thirteen bishops, and the largest portion of the best lands belong to the dignified clergy.

The *revenue* of Portugal, arising from the excise and the customs, which are extremely productive, from the monopoly of the tobacco trade, from the importation of precious stones, and from the domains belonging to the crown, is computed to be about four millions sterling per annum. The royal income is chiefly obtained from the sale of indulgences, from a fourth of all church dignitaries, of which his majesty has the appointment, and from donations from the pope. With a revenue so limited, their military force, previous to the late eventful struggle, was extremely small, inefficient, and ill appointed, but during the Peninsular war, aided by British funds and officers, their troops have been restored to their former respectability.

*Trade.*—The Portuguese still carry on a considerable trade, particularly with England, in the wines of their own country, and the valuable commodities supplied by the colonies which they still retain in Africa and the East Indies. They have few manufactures, being supplied in this department chiefly from England. They are not fond of husbandry, but have abundance of horned cattle, and they make large quantities of salt from sea-water, especially in the bay of St Ubes, from whence a great deal is transported. Their foreign trade consists chiefly in the exportation of the produce of their own country, or in the merchandise which they receive from their foreign settlements, such as sugar, tobacco, rum, cotton, indigo, and hides. Besides these, they have gold, silver, diamonds, and other precious stones from America, which bring them immense riches. Their home manufactures consist of linen, woollen cloths, paper, silk, glass, cambrics, thread, and earthen ware. In the northern districts the manufacture of wine is likewise very considerable; of which article they annually export to the value of about two millions sterling. But the greatest part of the import and export trade of this kingdom has long been in the hands of foreign merchants, particularly the British.

*The chief towns* of Portugal are, Lisbon, on the Tagus, which contains a population of 230,000; Oporto on the Douro; Coimbra on the Mondego; Setubal, Elvas, Evora, and Braganza.

The chief river is the Tagus, rising on the boundary of Castile, in the mountains of Molina; it empties itself into the Atlantic, after having watered and fertilised the inland country for upwards of 450 miles. This fine river, although navigable only to Lisbon, according to Mr Murphy, might at no great expense, and with little ingenuity, be rendered fit for ships of considerable burden, even so far eastward as Alcantara on the frontiers of Spain.

The Douro, another fine river, which is navigable about 60 miles, rises in Spain, and after flowing in a direction nearly west for 360 miles, falls into the Atlantic about four miles from Oporto. This river is navigable about 60 miles. The Minho, another river also flowing in nearly the same direction, after running about 100 miles, empties itself into the same sea, and forms in its course the northern boundary of the kingdom. The Guadiana, which rises in New Castile, on its entrance into Portugal takes a southerly course, and forms another boundary to this kingdom towards the south-east. Besides these, there are many smaller rivers of considerable note, such as the Mondego, the Vouga, and the Sadaon. Notwithstanding these noble rivers, Portugal is extremely defective in the means of internal communication, so that it has been found to be not more expensive to import articles from Brazil than to convey them by land to Lisbon from the remote districts of the kingdom. As some improvements have been commenced, it is hoped these obstructions to commerce will in time be removed.

*The Mineral Productions* of Portugal are gold and silver. Veins of the former have been found in several places, but particularly in the Serra de Estrella, and in the sands of many rivers, and a mine of the latter was wrought not many years ago in the vicinity of Braganza; but the discovery of Brazil, and the possessions of the Portuguese in the east, caused them entirely to neglect their own mineral productions. Besides these, there are mines of iron, tin, lead, emery, and marble; and abundance of antimony, bismuth, arsenic, quicksilver, manganese, rubies, jacinths, and beryls, are likewise to be found, so that few countries in Europe can boast of a richer display of minerals of almost every kind. In the northern provinces there have been mines of immense size, containing many subteraneous passages, and apartments of great extent, cut through the solid rock.

*The present constitution* of the government is very fluctuating and unsettled, so that it is impossible exactly to describe it. The government formerly was monarchical; but a great difference subsisted between the sovereignty of the king of Portugal and the king of Spain, for the pope's authority in this kingdom was extremely powerful, so that the king could not confer any benefice without his assent. The authority of the king was bounded by the laws of the kingdom, so that he could not raise any more taxes than were settled in 1674, nor could he appoint a successor in case of the failure of the royal line. There are in Portugal three orders of ecclesiastical knights, who enjoy great revenues, and who would be very formidable if the king was not grand-master. The government was vested in four ministers and secretaries of state, and each province had its separate governor, and every city its own magistrates; but the salaries of the governors and judges being small, the laws are partially administered. The people are much addicted to superstition, and the king is entirely under the control of the clergy.

The history of the kingdom of Portugal is as follows: In the eleventh century, Henry duke of Burgundy, having assisted Alphonso, king of Leon and Castile, against the Moors, received, as a reward for his services, that monarch's daughter, Theresa, in marriage, with a small portion of territory, and the title of Count. At his death his son Alphonso, an infant only three years old, succeeded, and Theresa took upon her the management of affairs during his minority. She appears to have been an ambitious and enterprising princess; for, after making encroachments upon the territories of her neighbours, and exciting wars, she was at last deposed by her son Alphonso Henriquez, who was the first that obtained the title of king of Portugal.

This prince, about the year 1139, having given the Moors a signal defeat on the banks of the Tago, was saluted king by his soldiers upon this victory. After this, renouncing all dependence upon the crown of Spain, he caused himself to be chosen and crowned king of Portugal before an assembly of the states, and got his title confirmed by a bull from Pope Alexander III. After having considerably extended his dominions, Henriquez died in the seventy-sixth year of his age, A.D. 1185.

He was succeeded by his son Don Sancho I. Of this prince it is remarkable, that, before he ascended the throne, he was of a restless and warlike disposition, whereas, after obtaining possession of the supreme power, he became a lover of peace, and began with great assiduity to repair the cities that had suffered most by the war, and to repeople the country around them. By his steady attention to the real interests of his kingdom, he soon greatly improved it, and procured to himself the glorious title of The restorer of cities, and father of his country. In the year 1189, by the assistance of a fleet, chiefly of English vessels, which had entered the river of Lisbon on their way to the Holy Land, he reduced the city of Silves in Algarvé, and the English were rewarded with the plunder; but after having several times lost this city, and re-taken it from the African Moors, who had invaded his kingdom, he caused it to be destroyed, in despair of being able to keep permanent possession of it. His last enterprise was the reduction of Elvas. At his death, which happened at Coimbra, after a reign of 26 years, he was succeeded by his son Don Alphonso. He left behind him a numerous family by his queen Dulcia of Arragon, and a treasure of more than 700,000 crowns in ready money, besides 1400 marks of silver, and 100 of gold plate, though he had maintained the character of being rather a liberal prince. He is, indeed, considered the best economist that ever occupied the throne of Portugal.

Hardly any thing of importance occurs in the history of Portugal till the year 1289, at which period a dispute arose between the crowns of Portugal and Castile, which, interrupted only by short and insincere reconciliations, continued to embroil the two kingdoms for a long time. At length, in the reign of John I., Don Juan of Castile, who had claims to the crown of Portugal, entered that kingdom with all the forces he could muster, consisting of about 30,000 men. With these he laid waste the country, while John, who was at the head of only a small army, remained inactive, waiting for some succours which he expected from England. These, however, not arriving, he ventured to give the enemy battle with what forces he had of his own, and notwithstanding the enemies superiority in numbers, he gave them a complete overthrow, and marching into Castile, obliged the king to conclude a peace, which secured the undisturbed possession of the throne of

Portugal.

Portugal. In 1414, John commanded, in person, a successful expedition against the Moors in Barbary; the city of Ceuta was taken at the first assault. The princes of Barbary, however, as soon as the king of Portugal was gone, formed a league to recover this city; the attempt was defeated by the sons of John, who had been sent hither to repel it; but the expense of retaining the possession was so great, that the king was advised to destroy it. He, however, thought it of so much importance, that he resolved to strengthen and enlarge the fortifications, and increase the number of troops. This city was lost by his successor, who, making an expedition against Tangier, allowed himself to be so shut up by the Moors, that he was glad to restore Ceuta, in order to obtain leave to return to Portugal. During the reign of this gallant prince, the Portuguese were not only triumphant in arms, but likewise the most distinguished in Europe for their cultivation of the arts and sciences. Under the patronage of this prince and his son Henry, various enterprises were undertaken, new countries were discovered, and learned men of every nation of Europe, whose labours could promote the advancement of science and literature, were encouraged and liberally rewarded.

When John II. mounted the throne, he found the kingdom in a ruined state, from the wars, both foreign and domestic, which had been carried on by his father; and his first care therefore was to improve the internal state of the kingdom. Under his auspices, navigation was much improved, and the character of the Portuguese was not more distinguished for their gallantry in the field of battle, than for the patience, courage, and perseverance with which they prosecuted their long and hazardous voyages of discovery. At this time, Columbus, returning after the discovery of America, first landed at Lisbon, and was received by this prince at the court of Portugal with great eclat. The reign of John II. was indeed glorious for Portugal; although, in a military point of view, nothing very remarkable occurred. The internal improvements of this prince's peaceable reign, and his great discoveries, tended much to increase the wealth as well as the power of the monarch.

The Portuguese continued at intervals to carry on the war against Barbary, but with no great success, and till the year 1497, nothing very remarkable occurs in their history. This year was rendered famous by the discovery of a passage to the East Indies round the Cape of Good Hope. Before this time the Portuguese had made considerable progress in their discoveries along the western shores of Africa, and had ventured far beyond the limits of ancient navigation on this coast. They had advanced at first with slow and cautious steps, till, emboldened by success, and finding that the countries under the torrid zone, instead of being uninhabited deserts burnt up by the heat, were fertile and populous, they became more adventurous; and lured on by the hope of gain, they pushed forward their discoveries, till they got sight of that cape, by doubling which they were to add so much to the wealth and glory of their country. It is no slight obstacle that will repress the adventurous spirit of men incited to enterprise by the two strongest passions in the heart—the desire of riches and renown. Accordingly, after various unsuccessful attempts, the southern promontory of Africa was at last passed by Vasco de Gama, a brave and skilful officer. Having doubled the Cape of Good Hope, he procured pilots on the eastern shore of Africa, who conducted him across the Indian ocean to those countries which he so ardently desired to reach; and on the 22d of May 1498, he landed at Calecut on the coast of Malabar. He was at first received with welcome, and treated with kindness and respect by the monarch of the country, who viewed every thing about his new guests with admiration; but soon thinking that their visit might prove more hurtful than advantageous to him, he began to wish to get rid of the Portuguese and their commander, and made several attempts to cut them off. Vasca, however, contrived to defeat his purposes, and returned to Portugal, loaded, not only with the commodities peculiar to that coast, but with many rich productions of the eastern parts of India. He was received with great kindness by the king, who created him count of Vidgueira and admiral of the Indies. Emanuel, who at this time reigned in Portugal, saw the advantages to be derived to his country from the discovery of the new route to the East; and by the excellent measures which he laid down for securing the trade of the Indies, and the prudent choice he made of officers to take the command of expeditions sent out to promote it, and take possession of proper stations from whence it might be carried on, he, in a short time, saw nearly the whole of the lucrative traffic between the kingdoms of the East and Europe in the hands of his subjects. The Venetians, who had long possessed the management of this trade, viewed the progress of the Portuguese with alarm, and endeavoured to check it, by inciting the natives of the countries where it was carried on to oppose it; but all their attempts were rendered abortive by the bravery and conduct of Emanuel's officers, who defeated all the schemes of their enemies, and took advantage of them to extend the dominion of their master; and Emanuel, before his death, had the satisfaction to see the commercial empire in the East, which he had been labouring to establish, nearly completed, very little of the trade passing through the hands of the Venetians.

Emanuel, who died in September 1522, was succeeded by his son John III. aged 19. This prince, in the year 1525, introduced the Inquisition into his country; and he appears to have been more occupied in propagating the religion of the gospel than spreading the terror of his arms. The university of Coimbra was improved and enlarged by him; and the far-famed George Buchanan was then, in 1547, first professor of Greek in that celebrated school; but, two years afterwards, having offended the religious bigotry of the nation, he was for 18 months confined in prison, after which he was sent to a monastery; and while he was in this situation he prepared that beautiful version of the Psalms, which, in purity and sublimity as a composition, has never been excelled even by the greatest poets of the Augustan age.

About the same time, the Sultan Solyman observing how much the power of the Portuguese was increased by their establishments in India, sent orders to the pacha of Egypt to employ his whole strength in order to supplant their power there. The pacha, accordingly, set sail from the Red sea with 4000 Janizaries, and 16,000 other land forces, on board his fleet. This formidable armament was, however, defeated by the bravery and enterprise of the Portuguese officers and soldiers, and their empire in the East remained unshaken. Success also attended the arms of Portugal in Africa, where they baffled the attempts of the king of Fez before the town of Safi. And as great jealousies subsisted among the Moorish princes, the Portuguese might have gained great advantages over them, had they been firmly united among themselves. But this was so far from being the case, that king John, under all circumstances, was content to keep possession of the fortresses already in his power, without attempting to extend his conquests. He exerted himself much in the settlement of Brazil in South America, which he brought into a very good state,—caused several strong towns to be erected there, and took all possible methods to encourage the conversion of the natives to Christianity. He also made many regulations for the welfare and happiness of his subjects. He had many designs of this nature in his mind; but, on a close examination of his affairs, he found his subjects, in general, to have been so much injured, by leaving their concerns to the inspection of his council, that he indulged in immoderate grief, which brought on a kind of apoplexy, from which he never recovered. After a reign of 35 years, he died in June 1557, and was succeeded by his infant son Sebastian III.

The Moors, supposing that a minority was a favourable opportunity for attacking their enemies, ventured to make some encroachments; but the regency was so ably administered by the king's grandmother that they gained nothing by their attempt, and were soon forced to abandon it. Notwithstanding the ability of her government, the Portuguese began to manifest such dislike to the sex and the country of the regent, (for she was a Castilian,) that she resigned the authority into the hands of Don Henry, the king's brother. By him Alexis de Moneses was appointed governor to the young king, and Gonsales de Gomera, with two other priests, for his preceptors. By these instructors the king's education was completely mismanaged; he became rash, inconsiderate, and obstinate; and these dispositions conspired to bring upon him a misfortune which ruined both himself and the kingdom. When he became of age, he was seized with a strong desire to distinguish himself against the Infidels, and undertook an expedition into Africa for that purpose, which proved unfortunate. But, in spite of this ill success, and all the powerful dissuasions of his friends and councillors, in the year 1577 he landed with another army on the shores of Africa, in order to reinstate Muley Hamet king of Morocco and Fez, who had been dethroned by his uncle Muley Moloch. In a great battle that soon took place, the Portuguese army was nearly annihilated, and their king and the flower of their nobility were lost. The fate of the king is variously related; but whatever became of him he was never seen after the battle. Prince Henry, the late king's brother, who now assumed the government, found the kingdom quite exhausted, both of men and money, by this unfortunate expedition, and was unable to engage in any thing of importance. At his death the crown was claimed by three competitors, the prince of Parma, the duchess of Braganza, and Philip of Spain. The latter soon decided the dispute in his own favour, if not by the justice of his claims, at least by the superiority of his power. He found means to corrupt the regents of the kingdom, and, relying on their assistance, sent the duke of Alva at the head of an army to take possession of it in his own power. The Portuguese perceiving that they were betrayed by their governors, chose Antonio, prior of Crato, for their king; but he was soon expelled from Portugal by the duke of Alva, and the whole kingdom and its dependencies submitted to Philip. This prince, endeavouring to conciliate the affections of the Portuguese, by allowing many of their ancient forms of government to remain, and the wealth of the East to flow through the same channels. But all his arts could never entirely reconcile the people to the Spanish government.

Antonio made several attempts to regain the crown, first by the assistance of France whither he had fled upon his defeat, and afterwards by that of the English when they had defeated the armada. But he proved unsuccessful, and died at last in France in an obscure condition. Several insurrections were excited during the life of Philip by imposters assuming the character of Sebastian, who had been lost in the battle against the Moors, but who was still fondly hoped to return by his credulous subjects. The disturbances thus excited, were all, however, without much difficulty, suppressed.

Philip drained all his dominions greatly, but particularly Portugal, in order to support the immense preparations he made for invading England. And during the reigns of the three Philips his successors, Ormus in the east, and Brazil in the west, were lost. Besides these losses of territory, many infringements upon the civil rights of Portugal had been made by the Spanish monarchs.

One of the most important privileges granted by Philip I. was, that the kingdom should remain separate and independent, and consequently that Lisbon should continue as much its capital as ever, the several supreme courts residing there, so that the natives of this realm might not be obliged to travel out of it in search of justice. So little, however, was this observed, that neither promotions nor justice were to be obtained without journeys, and Madrid was not more the capital of Castile than of Portugal. The viceroy was to be a native of Portugal or a prince or princess of the blood; yet when any of the royal family bore the title, the power was in reality in the hands of a Spaniard. These, and other grievances too numerous to be mentioned here, excited a general detestation of the Spanish government, and, in 1640, a revolution was effected, by which John duke of Braganza was declared king, with the title of John IV. Several ineffectual attempts were made by the king of Spain to regain his authority. The first battle was fought in the year 1644, in which the Spanish army was entirely defeated. Notwithstanding, John was obliged to maintain a defensive war during the whole of his life, and at his death in 1655 the war was renewed with great vigour. The Spaniards thought themselves secure of regaining their superiority in Portugal upon the death of this monarch; and, indeed, the situation of the kingdom seemed to justify their expectations. The king Don Alphonso was only 13 years of age, and reputed weak both in mind and body; the regency was in the hands of a woman, and she, too, a Castilian. But this princess, though not very cordially supported by the Portuguese nobles, acted with such prudence and vigour as to disappoint all the designs of the Spaniards against Portugal. She married her only daughter to Charles II. of England, and, by the assistance of that country, she was enabled to secure the crown of Portugal for her children. During her life she attempted to set aside her eldest son Alphonso, who was a weak and vicious prince, in order to secure the succession for his younger brother Pedro, who was a prince of greater promise; but the Portuguese, who dreaded the evils attending a dispute for the throne, would not consent. After her death, however, Don Pedro effected himself what his mother had tried in vain. Alphonso was compelled to abdicate, and Pedro was elected regent, under which appellation he governed 15 years, when, upon the death of his brother, he assumed the title of king. His government was marked with great prudence and vigour. He died on the 9th of December 1706.

He was succeeded by his son John V. during whose reign Portugal and Spain were completely reconciled. His successor, Don Joseph, restricted the power of the Inquisition, and showed by most of his acts that he had the good of his subjects at heart. During his reign, however, Portugal endured dreadful sufferings; it was visited by an earthquake, a fire, and a famine. Its noblest blood was made to flow on the scaffold to expiate an attempt to assassinate the prince; a chief order of ecclesiastics was banished from the kingdom; and France and Spain having declared war against Great Britain, resolved either to compel the King of Portugal to join the confederacy, or to visit his country with all the ravages of war. It was in vain that he promised to observe a strict neutrality, and urged the many obligations he was under to the King of Britain; his reasons were treated with contempt, and he was threatened with the vengeance of the united powers unless he instantly acceded to their demands. He continued firm in his attachment to Britain, however, and declared that "it would affect him less, though reduced to the last extremity, of which the great Judge is the sole arbiter, to let the last tile of his palace fall, and to see his faithful subjects spill the last drop of their blood, than to sacrifice, together with the honour of his crown, all that Portugal held most dear." This declaration was made on the 27th of April 1762, and France and Spain soon after jointly declared war against Portugal. And as their design in doing so was professedly to prevent Great Britain from the military and commercial use of the ports of that kingdom, their principal efforts were aimed at the two ports where the British chiefly resided, Oporto and Lisbon. However, after various unsuccessful attempts of the Spaniards to come at these places, they were forced to retire out of the country before the armies of Portugal, supported by troops from Britain; and a peace was concluded at Paris on the 10th of February 1763. Joseph dying without male-issue, the succession devolved on Mary his daughter. She had married his brother Pedro some time before the death of her father; but as she long laboured under mental imbecility, the executive government of the kingdom was entrusted to her son as regent.

In the war against republican France, Portugal acted as the ally of Great Britain. All the aid she gave, however, was a few troops, which she sent to the assistance of the Spaniards, and a small squadron which joined the British fleet. When peace was concluded between France and Spain, a war broke out between the latter country and Portugal, but was attended with no event of importance. A short time previous to the signing of the preliminaries of the peace of Amiens, Portugal concluded a peace with Spain, and on the 20th September 1801 a treaty of peace was also concluded with France. In 1807, it having become manifest that Bonaparte had designs of overturning the house of Braganza, the affairs of Portugal became the object of general interest. And when the French ambassador, after failing to obtain compliance with the demands of Bonaparte that the ports should be shut against all British merchants, quitted Lisbon, it was considered high time that the royal family should provide for their safety. Accordingly, as had been previously agreed upon with the court of Britain in case of this necessity, on the 29th of November, fifteen persons of the house of Braganza, and a considerable number of its most faithful adherents, embarked at Lisbon for Brazil, under the escort of a British fleet. In consequence of this measure, the emperor of France declared that the throne was abdicated, and that the kingdom should be considered as a constituent part of the French dominions. He dissolved the regency formed by the prince, sequestered all the property belonging to the crown, and that of all the nobles who followed him into exile. Soon after the departure of the royal family the French took possession of Lisbon; and General Junot, on whom Bonaparte had bestowed the title of Duke of Abrantes, assumed the administration of the new government. While Junot kept possession of Lisbon with French troops, the Spaniards armed themselves with a firm determination to resist the tyranny of Bonaparte; and almost all the north of Portuga, excited by this gallant example, rose also in arms. Though the presence of Junot's army prevented the inhabitants of Lisbon from imitating their brave countrymen in the north, yet they looked forward to the time when they should be enabled to join them in expelling their insulting invaders from Portugal. And accordingly, on the expulsion of the

Portugal.

French from the northern provinces, and the establishment of the prince regent's authority, when the army under the command of Sir Arthur Wellesley landed in Portugal, and its services were offered to the junta of Gallicia, they, confiding in their own strength, declined the offer, but advised that it should be used to expel Junot from Lisbon. Sir Arthur, in pursuance of this advice, landed his troops at Mondego bay, where he was soon joined by General Spencer with the corps under his command from Cadiz, and both immediately marched forward on the road to Lisbon. On the 12th of August 1808, the armies reached Lieria, and on the 15th the advanced guard, for the first time, came up with a party of the French at Aviedas. A slight action took place, occasioned principally by the eagerness of the British. A few days after this, Sir Arthur Wellesley resolved to attack General Laborde at Roleia. He did so, and succeeded in defeating that general, and driving him from some passes that lay on the road to Lisbon. Junot being informed that the British expected some reinforcements under Sir John Moore, resolved, notwithstanding their present success, to attack them before these reinforcements should arrive. For this purpose he left Lisbon with nearly the whole of the French forces under his command, and arrived on the morning of the 21st at Vimiera, near which place the British troops were posted. A battle ensued, in which the French were defeated with the loss of thirteen pieces of cannon, and about three thousand men killed and wounded. The loss of the British in killed, wounded, and missing, amounted to nearly eight hundred. The event of this battle was the evacuation of Lisbon by Junot, in terms of the convention of Cintra.

In 1809 Portugal became again the scene of contest between France and her opponents. The British government having, by a treaty with Spain, engaged to aid the patriots in their struggle against the tyranny of France, it was thought desirable to accomplish the expulsion of the French from Portugal; and, to effect this, Sir Arthur Wellesley sailed from Portsmouth to take command of the British army, which now amounted to about 30,000 men. Upon Sir Arthur's arrival at Lisbon, he resolved to march against Marshal Soult, and dispossess him of Oporto; but that general, sensible of his inferiority, retired without waiting for his enemies. The British general having placed Oporto in a proper state of defence, was obliged to return to the south of Portugal to meet the French armies, which were advancing against Lisbon. Lord Wellington soon perceived that no place in Portugal presented so favourable a situation for defending the kingdom as the lines of Torres Vedras. This situation was so well chosen by the British general, and the whole of his operations so well conducted, that the designs of the French in this quarter were completely defeated; and in 1812 their armies were ultimately expelled from Portugal, which, from this period, continued to be governed in peace by a regency till the year 1820, when a revolution took place, which recalled the royal family from Brazil.

The revolution was commenced by the troops of Oporto on the 23d of August. At day-break, the troops of the line and the militia assembled under arms, and the officers proceeded to form a military council, which published two proclamations; at half past eight o'clock they marched to the Prada Nova, and posted themselves in the front of the public hall, the governors, bishop, and other authorities having arrived, the proclamations were read in their presence, and it was universally agreed on to establish a provisional government, with power to call the cortes, for these to form a constitution. This agreement was sworn to; the same was published to the people and troops, who welcomed the intelligence with loud and repeated shouts of "Long live King John VI.! Long live the Cortes and constitution." Every thing was conducted with the greatest harmony and good order. Not a drop of blood was spilt, nor was a dissenting voice heard. The regency perceiving that it would be in vain to oppose the establishment of the constitution proposed, speedily assented to it, and the election of deputies for the Cortes soon took place, all the members of which took the following oath: "I swear faithfully to fulfil, in the exercise of the powers which have been given me, the duties of deputy to the extraordinary Cortes, which are about to make the political constitution of the Portuguese monarchy, and the reforms and ameliorations which they shall judge necessary for the good and prosperity of the nation, the Catholic apostolic Roman religion, maintaining the throne of Don John VI., king of the united kingdoms of Portugal, Brazil, and Algarve, and preserving the dynasty of the serene house of Braganza." News of what was passing in Portugal soon reached Brazil; and the king and the princes swore to the constitution at Rio Janeiro, in compliance with the wishes of the people. And soon after, the king, leaving his eldest son as regent of Brazil, set sail for Portugal, where he landed on the 4th July 1821. Immediately after his arrival, the king repaired to the hall of the Cortes, and having taken his seat on the throne, the book of the Holy Gospels was presented to him by the president, and his Majesty laying his hand on them, pronounced the following oath: "I, John VI., by the grace of God, and by the constitution, king of the united kingdoms of Portugal, Brazil, and Algarve, swear upon the Holy Gospels to maintain the Catholic Apostolic Roman religion, to observe, and cause to be observed, the basis of the constitution decreed by the general, extraordinary, and constituent Cortes of the Portuguese nation, of the constitution which they shall make, and to be in all respects faithful to the said nation." It was afterwards stated to the Cortes, by the president, that when his Majesty had taken the above oath, he added the following words, which were heard by all the secretaries who were near his Majesty: "And all this is true, and I swear with my whole heart." The Cortes continued to make such enactments as they thought desirable for the consolidation of the system, which were all sanctioned with the utmost apparent cordiality on the part of the king. One important result of this revolution was the abolishing of the Inquisition. The removal of the Portuguese court from Rio de Janiero excited in the minds of the Brazilians a desire of becoming free from all subjection to the mother country. And, accordingly, they in a short time declared their independence, and placed the king's son at the head of their government, under the title of constitutional emperor, and perpetual defender of Brazil.

See Vertot's *Hist. des Revolutions de Portugal*; Link's *Travels in Portugal*, translated by Hinckley; Murphy's *Travels in Portugal*; and also his *State of Society in Portugal*; Dr Halliday's *Present State of Portugal*; Adrien Balbi's *Essai Statistique sur les Royaume de Portugal et d'Algarve*, Paris, 1823; also Lasitau's *History of the Portuguese Discoveries and Conquests*, 2 vols., Paris 1733.

POSEN, or Posna, the capital city of Russian Poland, situated at the confluence of the Wartha and Prozna, contains a population of about 20,000. Among the public buildings of Posen are the cathedral, the council-house, the guard-house, the cidevant Jesuits college, a theatre, a gymnasium, a college for educating teachers, several churches and convents, and also the episcopal palace, which is a superb edifice. The castle is situated on an island in the Wartha; the chief manufactures of Posen are leather, linen goods, watches, and fire-arms. The articles commonly exported are corn, wool, and timber.

POSITION, in architecture, the situation of a building with respect to the points of the compass. The best position is said to be that in which the four sides of the building directly face the four cardinal points; some, however, are of opinion, that if the angles be placed opposite the cardinal points, the four sides of the building will receive the benefit of the sun's rays more equally throughout the year.

POSITION, Trial and Error, or The Rule of False, in arithmetic, a rule employed for resolving such questions as do not admit of a solution by any direct process depending on the other rules of common arithmetic, and in which the numbers to be found do not ascend above the first power. See *Arithmetic*, under Mathematics.

POSSE COMITATUS, in law, signifies the assistance of all persons in a county above the age of 15, except women, ecclesiastics, and such as are disabled by disease or other infirmity. It is the duty of the sheriff to raise the *posse comitatus* in order to suppress riots, or to assist justices in putting their sentences into execution when opposed, to enforce the king's writ, &c.

POSSESSION, in law, is either actual where a person actually enters into lands or tenements descended or conveyed to him: or where lands are descended to a person, and he has not yet entered into them. Long possession, even when no deed can be shown, is more regarded in law than an ancient deed without possession. Thus, if a person who has obtained a property either by force or fraud die, and his heir enter into possession of the property, the rightful owner cannot turn him out till he sues him at the law; and the person in possession will be considered the proper owner, till the other not only disprove his claim but establish his own. And if a person is allowed to retain undisturbed possession for a certain number of years his right becomes incontrovertible.

POST, from *positus*, placed or set, signifying an upright stake or post, a military station, an office, an operation in book-keeping, a conveyance for letters, or a mode of travelling. Posts are used both in building and in fencing ground. Much of the strength of brick buildings depends upon the posts used, as the whole fabric is held together by their means. To preserve posts from rotting, which are to be set in the ground, a good coating of pitch or tar is more to to be relied on than the practice of burning, which is sometimes recommended.

POST, in war, a military station, as the out-posts, that is, parties of soldiers posted at some distance in front of the main army. In relating the operations of a campaign, any place adapted for encamping, or making an advantageous stand against an enemy, is called a post. In a defensive war, the ability of a general is principally displayed in making a judicious choice of posts. The chief things that recommend a place for being occupied as a post are its affording opportunities of annoying the enemy, by sending out parties to reconnoitre, surprise, and intercept them in their movements, and its having some natural defence, as a wood, river, or morass in front or flank, to make it difficult of access to an invader.

POST, a mode of travelling, or a conveyance for orders and despatches. As the speedy and regular transmission of their orders to distant parts of the empire would be an object of great importance to kings, the advantage of having posts or stations appointed along the roads, at which messengers bearing despatches might stop and be refreshed, and either relieved by a fresh runner, or supplied with fresh horses, was early perceived and acted upon. Such stations are said to have been adopted by Cyrus, about 600 years before Christ. It is not well known when posts were introduced among the Romans, but some improvement was made in the system by Augustus, who appointed horses and chariots to ply between the stations in place of the runners on foot, who were employed in this department before his time. The Emperor Charlemagne is the first, in modern history, that is mentioned as having instituted posts. Having reduced Italy, Germany, and a part of Spain under his dominion, about the year 807 he established three great posts to keep up the communication with these provinces. These establishments were, however, neglected upon the death of Charlemagne, and we hear no more of posts till 1464, when they were revived by Louis XI. of France; from that kingdom they gradually spread over Europe. In eastern nations, couriers run their prescribed distances with astonishing velocity, and delivering their despatches to fresh persons, they are by this means conveyed almost as rapidly as by horses. In England there appears to have existed posts of some kind or other as early as the reign of Edward III.; and under Edward VI. there was an act of Parliament passed fixing the rate of post-horses at a penny per mile, but these post-horses were probably designed only for the conveniency of travellers. This mode of travelling is similar to that now employed for the common post, not using the same vehicle or horses to perform the whole of the journey, but changing them at regular stages. Post is, therefore, a term synonimous with *courier*, and is supposed to have been derived from horses being *positi*, or placed as relays or changes at convenient distances, for the conveyance of despatches, to relieve those unable to proceed the whole journey at the speed desired. Horses employed for this and similar purposes are therefore called post-horses, their riders post-boys and postilions, and the houses for the reception of the letters post-offices. To so great perfection has this mode of travelling arrived in Britain, that the mail is now conveyed to the most distant corner of the empire at the rate of nine miles in the hour, including stoppages. In 1581 mention is made of the appointment of a chief post-master for England, but what were the duties of his office does not clearly appear.

Post-Office, *for conveyance of letters.*—An office of this kind was established by James I. But it was during the civil war, and under the protectorate of Cromwell, that the plan upon which the post-office is at present modelled was instituted. The establishment of the general post-office for Great Britain consists of two post-masters-general, a secretary, surveyor, and comptroller-general, with upwards of 150 assistants and clerks for the head letter-office in London. In 1711, a chief letter-office for Scotland was erected at Edinburgh, and a postmaster-general for North Britain, with other necessary officers appointed. All the deputy postmasters in Scotland are under his immediate direction, while he himself is under the control of the postmaster-general for Great Britain. About the year 1784, in pursuance of a plan suggested in 1782 by Mr John Palmer, the mails began to be conveyed by the stage coaches or diligences then established between most of the large towns, which ensured a more safe, speedy, and regular transmission of despatches than that of post-boys on horseback, formerly in use. See Mail.

Post-horses were at first employed chiefly for travelling, and the carriage of packets and letters was but an occasional service. When the post-office was originally established in Britain, it was intended for the conveyance of letters to and from foreign parts, and it was placed under the management of M. De l'Equester. Earl Stanhope afterwards claimed this office, but it was given by Charles I. to William Frezel and Thomas Witherings in 1632; and three years afterwards Charles erected a letter-office for England and Scotland. The rates of postage for every single letter, for a distance less than 80 miles, was twopence; from 80 to 140 miles, fourpence; for all above that distance sixpence, and for every single horse employed in the conveyance of letters, postmasters were allowed twopence-halfpenny per mile. These posts, however, were established only upon a few of the principal roads. The general post-office was originally situated in Clerk Lane, but was afterwards removed to the Black Swan in Bishopsgate Street, and finally to Lombard Street; and although it has been repeatedly enlarged and improved, it is still found to be inconveniently small. The penny-post, for the accommodation of the inhabitants of London, was established in the reign of Charles II., after much opposition and expence, by Messrs Docwra and Murray; and the projectors, after a prosecution from government in the Court of King's [illegible]h, had the mortification to find that it was adjudged a [illegible]anch of the general post-office belonging to his Grace [illegible]ke of York.

To prevent unjust reflections, and to shew that no unnecessary delay took place in the transmission of letters, stamps were provided, to be set on each letter every hour of the day when the letters were given out for delivery, so that the individuals might compute the time and distance, and thereby discover where the fault lay if the letters should not be delivered in proper time; and in consequence of such salutary regulations, the penny-post has flourished for more than an hundred years. At the close of the last century, government took this office under their own immediate inspection, and to meet the increased expenses doubled the postage, so that it now is known by the name of the two-penny post. In the original institution of the post-office, one object was to have the means of inspecting the letters of individuals, and discovering any conspiracy against the government, as all letters that are suspected may be opened by an order from the Secretary of State. Sending of letters, therefore, by private conveyance and carriers, being injurious to this useful establishment, is declared to be unlawful, so that letters coming from abroad by private ships, although even belonging to the owners, are required to pass through the post-office. Newspapers, however, are conveyed through all parts of Great Britain gratis, and may now, on the payment of three halfpence for each paper, be sent abroad. Letters sent out of England to foreign countries must pay the inland postage, and so great is the vigilance of the officers, that although millions of money pass through the post-office, it is very seldom that any individual ever sustains the smallest loss. Members of Parliament have the privilege of sending and receiving all their letters free of any charge; and for this purpose a warrant was issued to the postmaster-general, directing this allowance to the extent of two ounces in weight; but so great became the abuses in this practice, that the annual amount of packed letters in the year 1763 amounted to L.170,700. More strict regulations were adopted, but notwithstanding the revenue by this privilege lost L.80,000 a year. No member is entitled to send more than ten letters free of postage in one day, nor to receive more than 15, and no letter can be exempted from postage if it exceeds one ounce in weight. By these and many other judicious regulations the revenue of the post-office now exceeds two millions Sterling per annum.

POSTERN, or Sally Port, in fortification. See War.

POSTHUMOUS, a child born after the death of the father, or taken out of the body of a dead mother. Hence the term is frequently applied to the works of an author not published till after his death.

POSTULATE, or Postulatum, in logic, geometry, &c. a demand or petition for assent to some proposition, of a nature too obvious to require or even admit of demonstration; as, Let it be granted that a straight line may be drawn from any one given point to any other given point.

POSTURE, in painting and sculpture, the situa-

Potato.

tion of a figure . . regard to the eye, and of the several members of the body with regard another, whereby its action is expressed. A considerable part of the art of a painter consists in adjusting the postures of his figures, or giving them the most agreeable ones. Postures are either natural or artificial. Natural postures are such as nature seems to have had a view to in the mechanism of the body, or rather such as the ordinary actions of life lead us to exhibit while young, and the joints and muscles are flexible. Artificial postures are those which some extraordinary views or studies lead us to learn; as those of dancing, fencing, &c. Such also are those of balance and posture-masters. It is related in the Phil. Trans. of one Clark, a famous posture-master in London, that he had such an absolute command of his muscles, &c. that he could disjoint his whole body, so that he imposed on the great surgeon Mallens, who considered him in such a miserable condition that he would not undertake his cure. Though a well-made man, he could appear with all imaginable deformities—hunch-backed, pot-bellied, sharp-breasted, &c. He disjointed his arms, shoulders, legs, and thighs; and rendered himself to all appearance such an object of pity, that he frequently extorted money, in quality of a cripple, from the very company in which he had immediately before been in quality of a comrade. He would make his hips stand a considerable way out from his loins, and so high as to invade the place of his back; yet his face was the most changeable part about him, and showed more postures than all the rest.

POTATO.—This valuable root was first brought from Virginia by Sir Walter Raleigh, who, on his return homeward, in the year 1623, stopping at Ireland, distributed a number of potatoes in that kingdom, which were planted, and being found to produce a plentiful crop of wholesome food, the cultivation of them soon became general. From thence they were introduced into England by a vessel wrecked on the western coast, called North Meols, in Lancashire, a place still famous for producing excellent potatoes. It was forty years after their introduction, however, before they were much cultivated about London. At a meeting of the Royal society, March 18, 1662-3, a letter was read from Mr Buckland, a Somerset gentleman, recommending the planting of potatoes in all parts of the kingdom to prevent famine. This was referred to a committee; and, in consequence of their report, Mr Buckland received the thanks of the society. Such members as had lands were exhorted to plant them; and Mr Evelyn was desired to mention the proposal at the end of his Sylva. Notwithstanding the great and acknowledged benefits that have resulted to the country from the cultivation of potatoes, Mr Cobbett, in his zeal against existing practices, lately attempted to persuade the people of England to abandon them, as both an unwholesome and unprofitable production. But to all who have been accustomed to the use of them, they stand recommended by so many excellent qualities that they are likely to gain ground in spite of all the rhetoric of this popular writer. Indeed, it is probable he would find it easier to introduce universal suffrage into the empire, than to banish the cultivation of potatoes out of it. See AGRICULTURE and GARDENING.

Potential | Poultry.

POTENTIAL, in the schools, is used to denote a kind of qualities supposed to exist in bodies *in potentia* only, by means of which potential qualities bodies are capable of impressing on us the ideas of such qualities, though they themselves have in reality no such qualities inherent in them, in this sense we say potential heat, potential cold, &c.

POTOSI, a large and important city of Peru, in South America, in the viceroyalty of La Plata, situate at the bottom of a mountain of the same name, celebrated for the richest silver mine in the world. This mine was discovered, 1545, in the following manner: An Indian, called by some Gualca, by others Hualpa, pursuing some wild goats to the mountain of Potosi, and arriving at a very steep part, laid hold of a shrub to assist his ascent, but the shrub coming away by the roots, discovered a mass of fine silver. After several visits to the mountain, a friend, who had taken notice of an improvement in his circumstances, prevailed on him to discover the secret. They went several times to the mountain in company; but Gualca refusing to discover his method of purifying the metal, his companion in disgust revealed the whole secret to his master, a Spaniard, who immediately began to work the mine. Two years after the discovery of this mine was founded the city of Potosi.

POTSDAM, a town of Brandenburg, in the Middle Mark, situate in an island ten miles in circumference, formed by the rivers Sprae and Havel, thirteen miles from Berlin. This city contains various magnificent buildings. The royal palace is much admired. In the garrison church, which is large, there is a pulpit of marble, and under it the tomb of the great Frederick. In the market-place there is an obelisk of marble 75 feet in height, and marble statues of the four first kings of Prussia. Manufactures of silk, velvet, cotton, linen, &c. are carried on at Potsdam. Soon after the battle of Jena, the French entered this city and carried off the sword and scarf which Frederick wore during the seven years war.

POTTERY. See PORCELAIN.

POULTRY, a term applied to all kinds of domestic fowls. Among birds of the poultry kind may be ranked all those that have white flesh, and bulky bodies in comparison to their heads and limbs. They are furnished with short strong bills for picking up grain, which is their chief food. Poultry are the only kind of birds that grow fat in confinement; many of the wilder birds pine away, or refuse all sustenance when cooped or caged up, but poultry always feed well when in health.

The best age to set a hen for chickens is from two years old to five, and the best month to set them in is February, though any month between that and October is good. The object of setting them in these months, is to have the broods of chickens coming in as the season gets warm in the spring. A hen sits twenty-one days, but geese, ducks, and turkeys sit thirty. Where people pay much attention to the keeping of poultry, a poultry house is necessary. This should contain an apartment for the general stock to roost in, another for sitting, a third for fattening, and a fourth for food. For sitting, both turkeys and hens nests should be made in lockers that have lids with hinges, to confine them if necessary, else two or three will crowd into the same nest. All must have access to a gravelled yard, and to grass for range. The building should have clear water near, and should be kept clean, and well white-washed to destroy vermin.

In the view of fattening chickens or other poultry, various modes are used; but the best is probably that of confining them for a few days in dry well ventilated places, covered so as to prevent the entrance of too much light. In these situations they should be fed three or four times in the course of the day, with well roasted or steamed potatoes, which are probably the cheapest sort of food. Buck wheat is considered a proper and cheap food for this purpose, either given whole or ground into flour, barley-meal, ground malt, and also coarse wheat-flour mixed up with water. See Hatching and Ornithology.

POUNCE, gum sandarach, used to prevent ink from sinking in paper; also a little heap of charcoal dust enclosed in a piece of muslin or other open stuff, to be passed over holes pricked in a work, in order to mark the lines or designs thereof on paper, silk, &c. placed underneath.

POUND, a well known weight, usually denoted by lb. the abreviation of *libra*, the Latin for pound. The pound is of two kinds, Avoirdupois and Troy; the one is divided into sixteen ounces and the other into twelve. The pound Avoirdupois is to the pound Troy as 700 is to 576. Things that are hardly subject to any waste, as gold, silver, and precious stones, are weighed by the pound Troy, and chemists make use of it in most of their experiments. The pound Avoirdupois is used for weighing most kinds of merchandise, and things of a coarse and drossy nature, that are subject to considerable waste. As a statute has lately passed for the better regulation of weights and measures, the reader is referred for a detailed account of these under the article Weights.

POUND, an imaginary coin, or money of account, employed in several European states. It was so called because a pound of silver in ancient times weighed a pound Troy. The pound Sterling of this country was an imaginary coin, till the gold pieces of that value, named sovereigns, were issued in the year 1817. The weight of a sovereign is 5 dwts. 5½ grains.

POUNDAGE, a subsidy of twelvepence in the pound, formerly granted to the crown on all goods or merchandise exported or imported.

POURSUIVANT, or Pursuivant, a messenger who in former times attended the king during his wars, or at council table, or in the exchequer, ready to be despatched upon any duty or message, as the apprehending of an accused or suspected person. In heraldry it means the lowest officers at arms. There used to be many of them in England, but now there are only four, viz. blue-mantle, rouge-cross, rouge-dragon, and portcullice. These have had a succession and been allowed salaries from the crown for some ages.

POUSSIN, Nicholas, a celebrated French painter, born in 1594, at Andel in Normandy. He received the rudiments of instruction in his art from a Flemish portrait painter; but in pursuit of better models he soon repaired to Rome, where he gained the patronage of Cardinal Barberini, nephew of Pope Urban VIII. but did not long enjoy it. Barberini being soon despatched on a legation from the pope,—Poussin, in consequence, was reduced to great distress, and disposed of some of his pictures at a very low price to gain support. He lodged with Il Fiamingo the sculptor; and, together with him, was often employed in measuring antique statues. Upon the return of Barberini he was raised from that state of obscurity into which he had been permitted to sink; and the fame of his pictures reaching France, he, after considerable hesitation, consented to return to his native country at the solicitation of Louis XIII. Upon his arrival he was assigned a pension and lodgings in the Thuilleries. During his residence here he painted an admirable historical picture representing Herod's cruelty, and the celebrated pictures of the seven sacraments of the Romish church. Having begun the labours of Hercules in the Louvre, his situation was rendered so disagreeable by the envy of the faction of Vouet's school, that he obtained permission to revisit Rome, whither he returned in 1642, taking a last farewell of his native country. Poussin lived till the age of 72, much admired at Rome. He excelled in landscape and historical painting. See Design.

POWDER, a compound of nitre, sulphur, and charcoal. See Chemistry.

POWER, in arithmetic,—see Mathematics.

POWER, in law, generally signifies authority received to act in another person's stead.

POWER, in mechanics,—see Mechanics.

POWER of a glass, in optics, the distance between the convexity of a glass and the solar focus.

PRAEMUNIRE, in law, is taken either for a writ so called, or for the offence whereon the writ is granted; the one may be understood by the other. The church of Rome, under pretence of her supremacy and the dignity of St Peter's chair, took on her to bestow most of the ecclesiastical livings of any worth in England, by mandates, before they were vacant, pretending therein great care for the church by providing a successor before he was needed. These provisions gave Edward I. so great offence, that he made a statute against them. The original meaning of the offence which we call praemunire was, therefore, the introducing a foreign power into the land, by rendering that obedience to the pope which constitutionally belonged only to the king. Various offences have been declared liable to the penalties of a praemunire. Among others, if the assembly of peers in Scotland, convened to elect their sixteen representatives in the British parliament, shall presume to treat of any other matter save the election, they incur the penalties of a praemunire. The punishment of praemunire is thus stated by Sir Edward Coke: " That, from the conviction, the defendant shall be out of the king's protection, and his lands and tenements, goods and chattels, forfeited to the king; and that his body shall remain in prison at the king's pleasure." Præmunire is now chiefly used for the punishment above-mentioned. It is observed, however, to the honour of our courts of law, that prosecutions for a præmunire are unheard of in them. The only instance of one to be found is in the State trials, when the penalties of a præmunire were inflicted on some persons for refusing to take the oath of allegiance in the reign of Charles II.

PRAGMATIC SANCTION, in the civil law, is defined by Hottoman to be a rescript or answer of the sovereign, delivered by advice of his council, to some college, order, or body of people, upon consulting him on some case of their community. The same answer given to any particular person is called simply a rescript. The term Pragmatic Sanction is chiefly used by modern writers for that famous ordinance of Charles VII. of France, drawn up at Bourges, with the consent of the most eminent prelates and grandees of the nation. The scope of the pragmatic sanction, intended as a barrier against the encroachments of the church of Rome, was to regulate the form of elections made by the clergy, to restore to every church its privilege of choosing its bishop, and to every monastery that of electing its abbot, &c. Pope Pius II. obtained from Louis XI. an abrogation of this sanction, and conferred on the king and his descendants the title of Most Christian. But as the parliament opposed the abrogation, and Louis discovered that he had been duped, the sanction continued in force till the time of Francis I., when it was abolished, and that monarch was invested with the privilege of nominating to bishoprics and vacant benefices.

PRAGUE, the capital of Bohemia, one of the largest cities in Europe, situated in a pleasant and fruitful country in the midst of gardens and fine fields, on the banks of the Moldau, and almost in the centre of the kingdom. It is the ancient seat of its kings, and stands on both sides of the river Moldau, which, though of great breadth here, is shallow and not navigable. Prague is divided into the Old and New Towns, and that called Small Side, the two former lying on the east side of the Moldau and the latter on the west. The whole is about twelve miles in circumference. This town is very pleasantly situated, but there are few good buildings in it. The cathedral, which is dedicated to St Veit, is a fine Gothic building, and contains some pieces of excellent architecture, the rich monument of St Nepomene, the guardian saint of the city, and many other magnificent tombs of great men. Here are 100 churches, chapels, and Jewish synagogues, besides 40 cloisters; also the great hall where the coronation feast is celebrated, which, next to Westminster, is said to be the largest in Europe. It contains 150 rooms, which are appropriated for public offices. The tribunals of the regency likewise meet here, whose halls and galleries are adorned with many noble and splendid pictures. The inhabitants of Prague are in general poor; their principal trade consists in the brewing of beer. The nobles and gentry, however, are said to be wealthy. The Old Town, which is less ancient than that part of it called Small Side, was founded in the year 795; the New Town was founded by Charles IV. in the year 1348. This monarch also founded the university of Prague in 1347. The number of students when John Huss was rector was not less than 40,000; and when their privileges were threatened to be retrenched by Charles V., 20,000 are said to have left it in one week, and 16,000 soon after. The library contains 100,000 volumes, and a manuscript of Pliny. This town has been often taken and plundered, and has suffered frequently by sieges. The greatest part of the merchants here are Jews, who deal in all sorts of commodities, but particularly in precious stones from the Bohemian mines. Its principal manufactures are those of woollen, cotton, linen, silk stockings, paper, and gloves. Here stands the church and hospital of the Holy Ghost, which is the residence of the Grand Masters of the holy order of Knights of the Cross with the red star, and of the Grand Prior of the order of Malta for Bohemia, Silesia, Moravia, Poland, and Hungary. Here also are several magnificent palaces, among which the most conspicuous are those of the archiepiscopal, and of the counts Coloredo and Wallenstein. The inhabitants are fond of gaiety, have numerous masquerades, much feasting, and splendid balls. The town is governed by the great Burgrave, and the chief tribunal, consisting of 12 stadtholders. The Bohemian crystals, which are made here into lustres and drinking glasses, being much esteemed, are vended all over Europe. These crystals are also set in rings and ear pendants, and manufactured into various other ornaments by the Jews. In Prague is an excellent academy for drawing and painting, numerous cabinets of medals and curiosities, a royal society of sciences, a patriotic society for arts, a society of agriculture, three gymnasia, three hospitals, and an institution for training schoolmasters. The town contains about 8000 Jews, and nearly 77,000 Protestants. See Bohemia, Vol. I.

PRAM, or Prame, a kind of lighter used in Holland and the ports of the Baltic sea, to carry the cargoes of merchant ships alongside, in order to load; also used to bring goods to shore.

PRATIQUE, or Prattic, in commerce, a negociation or communication of commerce which a merchant vessel obtains in the port it arrives in, and the countries it discovers. Hence to obtain a pratique is to obtain liberty to frequent a port, to go ashore, to buy and sell, &c.

PRAXITELES, a celebrated Greek sculptor, who lived 360 years before Christ, during the reign of Alexander the Great. His statues were highly praised by the ancients, particularly two of Venus. Many of his works were in the Ceramicus at Athens; among the rest the statues of Harmodius and Aristogiton, which Xerxes carried away, and Alexander afterwards restored. His most noted works were in marble, but he cast many statues in metal, which, as well as those in marble, were greatly admired. Praxiteles had a son, Cephissodorus, who inherited his skill and fame. See Design.

PRAYER, a solemn and serious address to the

Supreme Being, as the fountain of life and happiness; consisting of adoration, confession, supplication, intercession, and thanksgiving.

PREACHING, the declaration or public promulgation of the word of God. The following remarks on the manner of stating and delivering religious truths are from Blair: "The understanding must always be applied to in the first place, in order to make a lasting impression on the heart, and he who would work on men's passions, or influence their practice, without first giving them just principles, and enlightening their minds, is no better than a mere declaimer. Nevertheless, it should also be remembered, that all the preacher's instructions are to be of the practical kind, and that persuasion must ever be the ultimate object. It is not to discuss some abstruse point that he ascends the pulpit; it is not to illustrate some metaphysical truth, or to inform men of what they never heard before, but it is to make them better men; it is at once to give them clear views and persuasive impressions of religious truth. The eloquence of the pulpit, then, must be popular eloquence. One of the first qualities of preaching is to be popular, not in the sense of accommodation to the humour and prejudices of the people, which tends only to make a preacher contemptible, but, in the true sense of the word, calculated to make impressions on the people; to strike and to seize their hearts. I scruple not, therefore, to assert, that the abstract and philosophical manner of preaching, however it may have been sometimes admired, is formed upon a very faulty idea, and deviates widely from the just plan of pulpit eloquence. Rational, indeed, a preacher ought always to be; he must give his audience clear ideas on every subject, and entertain them with sense not with sound. But to be an accurate reasoner will be small praise, if he be not a persuasive speaker also. The chief characteristics of the eloquence suited to the pulpit, as distinguished from other kinds of public speaking, appear to be these two—gravity and warmth. The serious nature of the subjects belonging to the pulpit requires gravity; their importance to mankind requires warmth. These two qualities ought to be duly combined; for the grave, when it is predominant, is apt to run into a dull uniform solemnity; the warm, when it wants gravity, borders on the theatrical and light; gravity and warmth united, form that character of preaching which the French call *onction*: the affecting, penetrating, interesting manner, flowing from a strong sensibility of heart in the preacher to the importance of those truths which he delivers, and an earnest desire that they make a full impression on the hearts of his hearers."

PREAMBLE, in law, the beginning of an act of Parliament, &c. which serves to open the intent and explain the meaning of the subsequent clauses of the act, and the mischiefs intended to be remedied by it.

PREBEND, the maintenance a prebendary receives out of the estate of a cathedral or collegiate church. The term prebend is usually confounded with canonicate; yet there is a real difference. A prebend is properly a right which an ecclesiastic has in a cathedral or collegiate church where he officiates, to receive certain ecclesiastical revenues, and to enjoy certain dues either in money or in kind; whereas canonicate is a mere title or spiritual quality which a person enjoys, independent of any praestation, or any temporal revenue; so that the prebend may subsist without the canonicate, but the canonicate is inseparable from the prebend. Originally the prebend was only a livery or portion of things necessary to life, given daily; at present, the rents and profits of the church are divided into fixed portions, called prebends, which are enjoyed independently. Of common right, the bishop is patron of all the prebends, because the possessions were derived from him. In such case he prefers to them by collation, which is the same thing with institution, as no presentation is made; but if the prebend be in the gift of a layman, the patron presents to the bishop, who institutes in like manner as to another benefice, and then the dean and chapter induct them; that is, after some ceremonies, place them in a stall in the cathedral church to which they belong, by which they are said to have a place in the choir. Some prebends are donative. At Westminster, the king collates by patent, and by virtue thereof the prebendary takes possession without institution or induction; and the king, at this day, is patron of most of the great prebends. Prebends are distinguished into simple and dignitary; a simple prebend has no more than the revenue for its support; but a prebend with dignity has always a jurisdiction annexed to it. No person may hold more than one prebend in the same church.

PRECEDENCE, the right of taking the more honourable place. This is either of courtesy or of right. This prerogative is allowed to old age, &c. by courtesy; that is to say, by the laws of politeness that happen to prevail in a country. That precedence which is of right is settled by law, and any infringement of it is punishable. See HERALDRY.

PRECESSION, RECESSION, or RETROCESSION of the Equinoxes. See ASTRONOMY.

PRECIPITATE, a term in chemistry. To precipitate is to disengage any substance from the solution with which it is united, by means of some substance having an affinity for the one to be disengaged. Thus, if a little oxalic acid be introduced into a glass of water holding lime in solution, the acid having an affinity for the lime will disengage it from the water, and falling along with it to the bottom forms oxalate of lime.

PREDESTINATION, according to the Calvinistic doctrine, is, "that God, for his own glory, fore-ordained whatsoever comes to pass; more especially, that he has destined certain individuals of the human race, called the Elect, to everlasting happiness, whilst the rest, denominated the Reprobate, are passed by and fore-ordained to everlasting misery." The same doctrine was maintained by the ancient stoics Zeno and Chrysippus, and after them by the Jewish Essenes; but it was not till about the beginning of the fifth century, according to the learned Mosheim, that it was introduced as an article of faith in the Christian church. That unalterable fate presides over nature, and controls both the actions and the condition of mankind, seems always to have been a favourite opinion among the vulgar. This was likewise the belief of the poets and philosophers of Greece and Rome; and the same doctrine of absolute predestination has been introduced by Mahomet into the Koran. Every event that can happen to any individual is represented as resulting from a previous determination of that Being who rules over all. Thus were the followers of the prophet inspired with a contempt of every danger, so that no obstacle could deter them in their efforts to extend the empire of his faith, nor could their zeal be abated by any opposition.

This doctrine of election and reprobation has produced one of the most perplexing controversies that has ever agitated the Christian church. It was at first broached by Pelagius, a British monk of great piety and learning, who lived at Rome about the commencement of the fifth century. He denied the original depravity of human nature, and maintained that men are born in a state as pure as that in which our first parents were originally created. On the other hand, the celebrated Augustine, bishop of Hippo, strenuously asserted the depravity of man in his present state since the fall, and the necessity of a special interposition of divine grace to enable him to do any one good action, and that none could obtain salvation but such as God thought fit to elect, and on whom he bestows his grace. After this dispute had for a considerable time been carried on with great zeal, it was decided by Zozimus, the bishop of Rome, in favour of Pelagius, whose followers were now called Pelagians, after their leader; but not long after, it was, by the council of Ephesus, formally condemned. The earliest reformers maintained the opinion of St Austin or Augustine; and one party of them, called Predestinarians, went even so far as to assert, that God had not only predestinated the wicked to punishment, but also that they should commit those very sins on account of which they are hereafter to be punished. Others, again, moderating this doctrine, were called Semipelagians, because they held that inward grace is not necessary to the beginning of repentance, but only for our progress in virtue; that faith depends upon ourselves, and good works upon God, and that predestination or election is made upon the foresight of good works. Luther and his followers first adopted and afterwards abandoned these opinions of Augustine, which are now called *Calvinistic Doctrines*, from the celebrated John Calvin, whose fame and eloquence as a teacher attracted great numbers to Geneva, from whence his doctrines spread with amazing success and rapidity throughout the greater part of Europe.

In 1662, however, Calvin's doctrines found a strenuous opponent in one James Arminius, first minister at Amsterdam, and afterwards professor of divinity at Leyden, whose followers adopted the name of Arminians or Remonstrants; and after this controversy had, for some time, been eagerly maintained on both sides, the Calvinists, in a great measure through the influence of the Prince of Orange, ultimately prevailed, and the synod of Dort, in 1618, condemned the Arminians as heretics. In consequence of this decision, the Arminians presented a remonstrance (which circumstance gave to them the name of Remonstrants) to the synod, containing a statement of their faith upon the points chiefly at issue between the parties, which embraced the following articles: 1. That God, from all eternity, predestinated those to everlasting salvation whom he foresaw would believe in Christ unto the end of their lives, and predestinated obstinate unbelievers to everlasting punishment. 2. Jesus Christ died for the whole human race, and for every individual of it, but believers alone reap the benefit of his death. 3. No man can produce faith in his mind by his own free will; but it is necessary that man, who is by nature wicked, and unfit for acting or thinking aright, should be regenerated by the grace of the Holy Spirit, imparted by God for Christ's sake. 4. His divine grace constitutes the source, the progress, and the fulfilment of all that is good in man; but it is not irresistible in its operation. 5. Believers, by the assistance of the Holy Spirit, are abundantly fitted for every good work; but whether it is possible for those who have once been truly such to fall away, and to perish finally, is not clear, and must be better enquired into by searching the sacred scriptures.

The Calvinists presented also their remonstrance, containing a statement of their religious opinions upon the subject of this dispute, and of which the synod approved. The Confession of Faith, compiled by the assembly of Divines at Westminster, which met 1643, embraces the substance of this remonstrance, and has adopted nearly the same expressions, and which, previous to his admission, every clergyman and probationer for the ministry in Scotland is required to subscribe. It gives a clear and distinct statement of the Calvinistic doctrine on this point, and runs as follows: "God, from all eternity, did, by the most wise and holy counsel of his own will, freely and unchangeably ordain whatsoever comes to pass; yet so as thereby neither is God the author of sin, nor is violence offered to the will of the creatures, nor is the liberty or contingency of second causes taken away, but rather established. Although God knows whatsoever may or can come to pass upon all supposed conditions, yet hath he not decreed any thing, because he foresaw it as future, or that which would come to pass upon such conditions. By the decree of God, for the manifestation of his glory, some men and angels are predestinated into everlasting life, and others are fore-ordained to everlasting death. These angels and men, thus predestinated and fore-ordained, are particularly and unchangeably designed; and their number is so certain and definite that it cannot be either increased or diminished. Those of mankind that are predestinated unto life, God, before the foundation of the world was laid, according to his eternal and immutable purpose, and the secret counsel and good pleasure of his will, hath chosen in Christ unto everlasting glory, out of his mere free grace and love, without any foresight of faith or good works, or perseverance in either of them, or any other thing in the creature as conditions or causes moving him thereunto; and all to the praise of his glorious grace. As God hath appointed the elect unto glory, so hath he, by the eternal and most free purpose of his will, fore-ordained all the means thereunto. Wherefore they who are elected, being fallen in Adam, are redeemed by Christ; are effectually called unto faith in Christ by his spirit working in due season; are justified, adopted, sanctified, and kept by his power through faith unto salvation. Neither are any other redeemed by Christ, effectually called, justified, adopted, sanctified, and saved, but the elect only. The rest of mankind, God was pleased, according to the unsearchable counsel of his own will, whereby he extendeth or withholdeth mercy as he pleaseth, for the glory of his sovereign power over his creatures, to pass by, and to ordain them to dishonour and wrath for their sin, to the praise of his glorious justice."

Such Calvinists as maintained that God, in order to display his awful justice and free mercy, had absolutely decreed the fall of Adam from eternity, and who place election first in the order of the decrees, are called Supralapsarians; while those who contend that Adam was permitted to fall, are called Sublapsarians. In the order of decrees, they place creation and the fall of man before election, and the latter before or after Christ's mission, according as they were particularists or universalists. The church of Rome was likewise involved in this controversy; but the council of Trent, which seemed on the whole to favour the Semipelagian system, being anxious at same time that predestination should have as little practical influence as possible on moral conduct, decided, that " no man, while he remains in this mortal state, presume that he is among the number of the *elect*, and that therefore he cannot sin, or sin without repentance, for it cannot be known who are elected without a special revelation from God." Of this faith were the first English reformers. Their doctrines were purely Calvinistic, as were those established in Scotland by the celebrated reformer John Knox, who had probably embraced these sentiments in consequence of residing at Geneva. This controversy concerning predestination, however, has at length resolved itself into a question of philosophical liberty or necessity, that is, into the question whether all human actions are not determined by motives. See *Liberty* and *Necessity*, under MORAL PHILOSOPHY.

The points chiefly at issue between the Calvinists and Arminians are these five: 1. As to election and reprobation, the former maintain that they are *absolute*, and the latter that they are conditional. 2. As to the extent of Christ's redemption, the former assert that it is particular, and the latter that it is universal. 3. As to the efficacy of grace, the Calvinists say it is irresistible, the Arminians that it is not irresistible. 4. As to the freedom of the will, the former maintain, that the will determines by motives and from necessity, and the latter, that it is at perfect liberty. 5. The perseverance of the saints, the former that they certainly persevere, and the latter that it is possible for those once in a state of grace to fall away, and finally perish.

The general objections to this doctrine of the Predestinarians are, that it is contrary to all our ideas of divine justice; that it represents God as rewarding without merit, and punishing without sin; that it makes him the author of evil, renders every good action on our part useless, every prayer absurd, and even the preaching of the gospel vain; that it is destructive of all moral distinctions, since all things are fixed by an immutable decree, and none can believe or be saved except the *elect*. To this the Calvinists reply, that *prescience* is the prerogative of God: but there can be no prescience of future contingencies; for if things are not certainly to be, they cannot be certainly foreseen; or if they are certainly foreseen, they *must* certainly be, and cannot, therefore, be contingent; and conditional decrees, they add, are absurd, in as much as they render the purposes of God subject to the will and actions of his creatures.

As to the benefits resulting from the *death of Christ*, although offered to all, yet that actually he only died for the elect, whom the father had chosen and given to him; for if God has received a sufficient satisfaction for the sins of the whole world, it would be an imputation upon the justice of God if all be not saved, or at least have the offer of salvation, that they may accept of it or not as they please. In regard to the *grace of God*, they contend that its efficacy is certain, and irresistible; and that it is not left to us to use it or not as we please, seeing that we are *born again*, that *we are created unto good works*, and *become new creatures*, and that God *works in us both to will and to do of his good pleasure*. Respecting the freedom of the will, it is maintained that all human actions are determined by necessity, that is, by motives arising from the character which God has impressed on our minds, and the train of circumstances amidst which we are placed; and, lastly, they assert, that in consequence of absolute decrees, and of irresistible grace, those who have once received this grace must certainly persevere and obtain eternal salvation—that all depends upon God, and *whom he loves he loves to the end*, and he has said that he will never leave nor forsake those to whom he becomes a God.

To these arguments the Arminians reply,—What can we think of that justice, holiness, and mercy, that shall condemn us for an evil action that we have never committed, or of a being who first of all proposes to be glorified by our being eternally miserable, and then decrees that we shall commit sins to justify his previous decree of our reprobation? or how can a just and benevolent being punish us for these actions which he himself, by an irresistible decree, has determined to be done? How can that being who is ever gracious and merciful, slow to anger, and abundant in compassion, by an antecedent absolute decree, fix our committing so many sins, so that it is not possible for us to avoid them, and then for committing them doom us to everlasting misery? and why offer grace and mercy, and exhort and urge us to accept of them, if by antecedent decrees he has determined that all these shall be ineffectual? Is it not, then, far more honourable to God, that his rational offspring should look up to him as the parent, guide, governor, and judge of moral agents, originally formed after his own likeness, with powers of reason and self-determination? Were we to form our ideas of the divine character upon the doctrine of absolute decrees, we would certainly derogate from his justice and mercy, and consequently from the excellence and glory of his perfections. The Arminians further reply, that the foresight of future contingencies involves no contradiction; that, from the prophecies of one age being fulfilled in another, it is obvious that future contingencies are certainly foreseen ; but where to found that certainty cannot so easily be resolved, and that we must therefore refer it to the infinite perfections of that Being who inhabiteth eternity, and to whom a thousand years are but as one day. The divine prescience does not make these events certain, because they are foreseen,—but they are foreseen because they are to happen; and this shews that the knowledge of a future event does not necessarily influence the causes or circumstances by which that event is produced.

As to the extent of the death of Christ, it is set in opposition to the sins of Adam; so that if, on the one side, *all* be concerned in his fall, or his sin, *all* must likewise have an interest in the death of Jesus, who is said *to be the propitiation for the sins of the whole world*. And further, to shew the *universality* of the object of his death, we are assured that God gave him that *whosoever believeth in him might not perish but have everlasting life*. In as far as freedom of acting is essential to moral agents, man is possessed of physical power to do what he pleases, and this power constitutes his liberty ; and it is a matter of fact, that every man has the power of acting and determining without being acted upon or influenced by any foreign cause ; and that in all those crimes with which men charge *themselves*, and for which they reproach *themselves*, God is not the agent, else this would excuse us and make him the author of sin. We can divert our thoughts, and restrain our passions on certain occasions, and on cool reflection; and hence we may conclude that man is free, and not under inevitable fate or irresistible influence to good or evil. On this ground the whole of sacred scripture is full of persuasions, reproofs, and exhortations ; threatenings, and encouragements. Were men totally incapable of any exertion, and utterly impotent till moved or acted upon by irresistible grace, which, when it is bestowed, nothing can resist, of what use could these solemn admonitions be, which could do no good, and, on those who are left to perish eternally, can have no effect. To what purpose would it be to urge the blind to see, the lame to run, or the dead *to work out their own salvation with fear and trembling*. Do not the scriptures indicate, that men not only can, but often do, resist the motions of grace, since it is said, *ye do always resist the Holy Ghost, as your fathers did, so do ye* ; and if the decrees of God be absolute, why are we required *not to grieve God's spirit?* And with regard to *perseverance*, the scriptures make many promises to them that *overcome, and who stedfastly persevere and are faithful to the death*. The apostle likewise declares, that the *just shall live by faith* ; but if he (any man is not in the original) draw back, *my soul shall have no pleasure in him*. The prophet Ezekiel also declares, that *when the righteous turneth* away from his righteousness and committeth iniquity, all his righteousness that he hath committed shall not be mentioned; in his sin that he hath sinned shall he die. And, lastly, against absolute decrees, it is stated that we shall all be judged according to our deeds done in the body, whether good or evil. The great difficulty in the doctrine of Calvin is to reconcile the unconditional decree of reprobation with divine justice and goodness, and the difficulty in the Arminian doctrine is how to account for the certainty of the foreknowledge of God upon the supposition of free will and a contingence of future events. To obviate the first of these, Dr Priestley and his followers have relinquished the doctrine of *reprobation*, maintaining that mankind are sent into this world only to prepare for another, and that the whole human race shall finally attain everlasting happiness, when *God shall be all and in all*. Considering the very difficult and perplexing nature of this controversy, there is great room for mutual charity and forbearance. The advocates of both systems entertain the highest reverence for the divine character, but although they admit the same principles they argue in a different manner. In supporting the honour of the divine perfections, the Calvinists and Predestinarians found all their arguments and reasoning upon the infinite perfection, independency, and absolute sovereignty of the Deity, making every difficulty respecting the divine government, free will, fixed fate, and absolute foreknowledge, yield to these principles ; while the Arminians, on the other hand, arguing from the higher veneration they entertain of the divine mercy, holiness, justice, and truth, make all their opinions correspond to those leading principles. The same general or leading principles are admitted by the supporters of both these systems, from which each party have reasoned plausibly; and although the dispute was formerly carried on with much keenness, it has now lost much of its violence. We fondly hope that the intolerant spirit which once prevailed in religious controversy will soon become utterly extinguished in every part of Christendom, and that the spirit of the gospel, which is a spirit of meekness, peace, and love, will ere long be introduced in its stead. If, from the fear of God, different men, in examining the scriptures, conscientiously arrive at different conclusions, even on points of the last importance, we trust that God will be merciful to him that is in error. Both seem to be actuated by the same principle, a high respect for the character of God ; and although that principle may impel them into different roads, may we not entertain the hope, that, if they add to their faith *charity*, they will meet in heaven. Certain it is that, from the apostolic age to our own, unanimity of sentiment in religious matters has never existed in the Christian church, and is, indeed, impossible ever to be attained ; so that all we can expect or hope for in religious opinions, is *mutual forbearance* and *mutual charity*,—dispositions which are ever the *most* conspicuous in the *most* enlightened minds.

PRE-EXISTENCE, existing before another. Thus God is pre-existent to all things ; and by the pre-existence of the soul is meant that it was in a state of existence before being connected with the body. For many ages this opinion prevailed among the Asiatic sages. From them, probably, was the metempsychosis transferred by Pythagoras to the philosophy of the Greeks. The sentiments of Socrates respecting the soul's immutability, delivered in his last interview with his friends, make it obvious that the transmigration of souls was a doctrine of the Platonic school. In the attainment of knowledge, and in all the operations of memory, these philosophers maintain, that retrospective impressions attend every object or idea which presents itself to the mind, and that all our thoughts, words, and actions are the effects of reminiscence, and indicate that those impressions have been made upon our senses or intellect on some former occasion. Such opinions, however ingenious, are too trifling to be seriously refuted. After the introduction of Christianity, this doctrine was taught by the Platonic proselytes, chiefly as an answer to those objections which had been deduced from the doctrine of original sin, and from the vices which degrade, and the calamities which disturb human life; and hence they maintained, that all the human race were actually concerned in their crime and participated their ruin. But, supposing that man had fully attained the capacity or dignity of a moral agent previous to the commission of original sin, this cannot remove the objections that have been urged against it; since it is admitted by all, excepting Pythagoras himself, that the consciousness of personal identity, which was felt in a state of pre-existence, is totally obliterated in the subsequent state. The nature of original sin, therefore, is inscrutably wrapt up in the bosom of Providence; nor can man make any further discovery of the origin and tendency of human misery than what can be deduced from divine revelation. The subordinate divinity of our Saviour, and his pre-existence to all time and before all worlds, was maintained by the Arians; but their opponents, the Socinians, considering him merely human, both as to his nature and person,—insisted that, before his incarnation, he was only pre-existent in the divine idea. Such have been the various opinions of mankind respecting the doctrine of pre-existence; but, without the continued impression of personal identity, the pre-existence of moral agents, whether rewarded or punished, can afford no solution of original sin.

See Aristotle *on the Soul;* Dr Watt's *Philosophical Essays*; and *the Principles of Natural and Revealed Religion,* by Chevalier Ramsay.

PREFACE, a short dissertation often prefixed to books, giving an account of their design, the plan and method observed in the work, and whatever may be necessary to enable the reader rightly to understand the subject under discussion in the book.

PREFECT, in ancient Rome, a magistrate who, in the absence of the kings, consuls, and emperors, was entrusted with the government of the city; taking cognizance of all crimes committed in it, and 100 miles round it. The jurisdiction of the prefect of modern Rome extends only 40 miles round the city; in other respects he has much the same powers as the ancient one.

PREFECT of the Prætorium, an officer first appointed by Augustus to take command of the Prætorian bands, which formed the emperor's body guard. As this was a place of great trust, succeeding emperors annexed many powers and privileges to it, in order to attach the prefect to their persons. Constantine at last greatly reduced the importance of this post.

PREJUDICES.—The term prejudice, from *præ* and *judicium,* signifying a preconceived opinion, or judgment before hand, is justly applied to all the opinions we either form or have been led to entertain without examination; and thus independent of these sound decisions of judgment and reason which are founded on our own observation, experience, or research. From a variety of causes, human judgment is liable to err, and these causes are, by logicians, denominated prejudices. The idea generally attached to prejudice is, of course, unfavourable, and, in common life, signifies an erroneous or ill opinion we have formed of some particular person. These rash judgments are frequently called prepossessions; and, in matters of science, prejudice denotes a false opinion or mistake, or a judgment formed respecting any thing without sufficient examination. Prejudice, however, is not always hostile to truth or rectitude, though it ought never to be the ground on which any sentiment is adopted as true, or on which any one plan of life is preferred to another. For the regulation of all our views and conduct, especially of religious belief and practice, nothing can be more essential than to be fully apprised of the various sources of prejudice and the forms it may assume; yet so numerous are both, and so apt to be modified by circumstances, that it has been found extremely difficult to analyse them, to arrange them philosophically, or present them in any clearly distinct and unexceptionably classified detail. Some prejudices originate in the general cast of the mind, without being referable to any one faculty of it. Others seem to be entirely accidental, arising from fortuitous causes; and not a few may be owing to the particular training of the individual. The best general rule is, doubtless, in all cases, rigidly to inquire, whether the decision we are forming, or the predilection we are cherishing, be the fair result of deliberative judgment, founded on a full and clear view of the subject, and not influenced by *extraneous* considerations. If a judge in a civil or criminal court shall suffer his sentence to be affected by any thing which has no strict relation to the cause; if favour be shewn, for example, to the person on trial, because he is rich, or noble, or a relative of the judge; or because he is poor, and therefore to be pitied, we instantly say the judge is chargeable with partiality,—his sentence is influenced by considerations which ought to have had no place in deciding the cause. This plain instance may serve as a guide to the mind, with regard to every conceivable species of erroneous judgment or prejudice. To this general rule, a brief notice of the chief sources and modifications of prejudices, without pretending to accurate classification, which has hitherto been found impracticable, may now be subjoined.

The long received distribution of prejudices was into four classes, which, by the celebrated Lord Bacon, were styled *Idols of the tribe*, *of the den*, *of the forum and of the theatre.* He calls those errors or prejudices *idols,* from their being regarded by mankind as objects of false worship. *Idols of the tribe* are those which are common to all mankind, and from which none are entirely free. These might be styled errors of authority, because we trust too much to authority, and do not sufficiently examine for ourselves. Thus we often go too far in judging of a man from his general company, and in forming opinions of others from ourselves. Erroneously, and from the same cause, did Virgil's Shepherd judge of Rome from his own village Mantua. The passions of men, which have at all times governed their judgments, likewise come under this class; and hence arise national prejudices, as those of the Jews, Greeks, and Romans; and hence, likewise, the pride of invention, which often makes men believe they have made great discoveries, when, in reality, they have made none at all.

*Errors, or idols of the den,* are those which arise from men's particular situations, from mental constitution, from their rank, education, and peculiar circumstances. They are not general as those of the tribe. In some characters the motives of intelligence overcome those of sensibility. Some form their judgments from reason rather than from taste; and, *vice versa*, some are of a sanguine temperament, and to them nothing appears wrong; and others, again, are cold and phlegmatic. Hence the passions of men, whether strong or weak, equally lead to error.

*Idols of the forum* are those errors which arise from the imperfection and abuse of language, as we commonly speak without paying attention to the precise signification of words, and likewise adopt the same language in explaining the operations of the mind, and in discoursing on subjects of science and philosophy. We speak of permanency and infinity, which, when applied to different objects, are terms extremely vague; and we say that the soul reflects, that the mirror and the water reflect, that the plant lives, and the man lives; and thus we use terms in philosophy which are quite vague and uncertain. These are, therefore, called errors of the forum, because philosophers employ the market or common use of words.

*The idols of the theatre* are the errors of system and of theory, arising both from the teachers and from the taught submitting to them implicitly. Thus the logic of Aristotle was at one period of time adopted by every person. Whatever he said was admitted to be right, and to such errors men long submitted without examination. They are called errors of the theatre, because they appear like actors for a time upon the stage. One presents himself, and is regarded for a time with attention. He again goes off, is neglected, and his successor occupies his place, and in his turn is listened to with respect. See PHILOSOPHY in this work.

Philosophers of modern times, viewing this subject in rather a different light, have arranged erroneous judgments or prejudices under the following heads: Prejudices arising from *things*, from *words*, from *ourselves*, and from *others*.

1. *Prejudices arising from things* are occasioned by the *obscurity of some truths*, and the great difficulty of searching them out. It was difficult, for example, to discover that the earth turned round its own axis, and revolved round the sun; and, till this was ascertained, men erroneously concluded that it was immoveable. Hence it is by diligent enquiry and reasoning that a prejudice of this kind can be removed; and, therefore, in matters of this nature, we ought to suspend our judgment till we obtain satisfactory evidence of the truth. Prejudices may likewise arise from *the appearance of things in disguise*, as in the case of some fruits which are lovely to the eye, but in reality are either poisonous or bitter, and hence such an erroneous opinion may be removed by resolving never to form a judgment of things from their outward appearance. Another cause of false judgment is *a mixture of different qualities in the same thing*; as when an author has advanced false and dangerous opinions in one part of his writings, we are disposed to reject the whole, although perhaps they contain matter of the utmost importance, from which we might not only have derived profit but amusement; or as when we admire a man for his great talents, we are apt likewise to admire and imitate his defects. To avoid this error of judgment, we ought to remember that every thing human possesses a mixture of good and bad. The next cause of erroneous judgment is *the different lights in which an object may be viewed by us*, although it be still the same,—as when an erect cone at a distance appears like a triangle, or when in a horizontal position it assumes the appearance of a circle. The last source of prejudice which we shall notice as arising from things, is the *casual association of many of our ideas*, as when we associate the idea of a coffin with a dead body, we should feel a great repugnance to have a piece of furniture made and ornamented exactly in the same manner, however useful it might be. To remove such a prejudice, we should consider if there be any natural and necessary connection between those ideas which our fancy and imagination have joined together, and endeavour to separate them again.

2. *Prejudices arising from words* are of two kinds, such as arise from single words or phrases, or such as are joined in speech or discourse. Of the first are those which arise from words that signify complex ideas. Hence a mistake is apt to arise, because one man includes more or less in his idea than another does. This occasions a confusion and a contest about ancient history, chronology, and various points in divinity, respecting faith, merit, election and reprobation, and among moralists respecting liberty and necessity. Similar mistakes likewise happen by the use of words that are equivocal and capable of different interpretations, and such as when several words are used to express the same thing, and are therefore synonymous. Of the second kind are those which arise from words joined in discourse or in speech; as when a person writes or speaks good sense, but has not a pleasing and engaging manner of expression, we are apt to condemn his work from the vulgarity or defects of the style, without appreciating the sentiments and ideas; and, on the other hand, we are apt to be led away by the beauty of the language, and to adopt the sentiments of the eloquent man, who often leads us into error, and persuades us, even when constituted as judges, to approve of what, upon more cool and deliberate judgment, we would condemn. To remove this error in judgment, we must separate our thoughts and ideas from words and phrases, and listen to nothing but truth, in whatsoever garb it may appear.

3. *Prejudices arising from ourselves* are those of *sense*, imagination, passions, self-love, temper, &c. Prejudices of *sense*, as when men think the earth a

Prejudices.

Prejudices.

level plain, because they cannot perceive any appearance of curve within the limits of their vision; and this prejudice or error can only be removed by study, and by the exercise of reason and experience. The errors of *imagination* arise from uniting or separating ideas so as to form a resemblance which exists only in the mind, but which we may be led to consider as real,—as when a man chuses a lottery ticket because his fancy has impressed him with the assurance that it will be prosperous; and this error is to be corrected by subjecting our ideas to the examination of reason and reflection, and not to believe it merely because it may have been suggested by fancy and imagination. The prejudices arising from the *passions and affections* of the mind are very numerous, have a powerful influence on the judgment, and become the occasion of many mistakes. Those of the benevolent kind are calculated to give charms to things that in themselves possess no attractions; and such as are malevolent have a contrary effect, and inspire us with worse ideas of men than they deserve, and frequently fill us with anger and wrath, sorrow and melancholy. To cure these prejudices requires us to be continually upon the watch, that they may never interpose and influence our judgment, and that we abstain from coming to any decided opinion when our affections are warmly engaged. Our fondness for *self* has a powerful influence upon our judgment, and is another fruitful source of error. Every thing that has relation to ourselves, we are apt to consider as peculiarly excellent. Every man's own country, town, or village is the most desirable, his own opinions in religion and philosophy are the most orthodox and true, or his own taste and inclinations are the standard by which he judges of his employment, study, business, and amusement.

4. *Prejudices arising from others* are all nearly akin, but, for the sake of distinction, have been classed under the heads of education, custom, authority, and such as arise from the manner in which a particular doctrine is proposed to us; but the great variety of prejudices which attend mankind in the present state, and the dangers of error to which we are continually exposed, render it impossible to particularise or even to enumerate the whole. Many other forms of classification have been adopted, and some of them connected with theories sufficiently beautiful and imposing, worthy of the great talents from which they have emanated. The disadvantage of the whole, which attaches also to our own detail, is, that certain prejudices are clearly referable to different sources, or a combination of causes; and that in some instances the classes proposed become so allied, if not completely identified, that it is impossible to preserve the distinction suggested, especially if the prejudice be looked to rather than its cause. Thus the prejudices formed in early life may at once be referred to memory, imagination, and sensibility, and the reason they are retained may be traced to mental indolence. Some there are, such as the dislike of innovations, which may in one person be owing to indolence, in another to the prejudice of education, in another to veneration for antiquity or the habit of submitting to authority, while in many all these causes may be combined.

In enumerating the chief sources and modifications of prejudice, we begin with *early impressions*, which, at the time they are made, are recommended by novelty, and usually connected with strong emotions of pleasure. These are apt to be long retained, and even to the end of our days powerfully affect us. Childhood is the period of almost constant excitement; youth the season of joy, gaiety, and hope. Imagination, a power stronger than reason, and earlier developed, attaches an inexplicable charm to the scenes of enjoyment, and spreads its fascination over all our social connections: impressions received in the glow of youthful susceptibility are, therefore, of all others, the most permanent and influential on future life. They tinge the very mode of thinking; they not unfrequently resist the calm dictates of reason at the outset of active life, or render averse to reasoning at all when it seems to break the illusion they have spread over the future; they are scarcely effaced or corrected by the force even of observation and experience. In old age, when memory fails to retain later occurrences, the reminiscences of youth come vividly upon us. All that was defective or annoying even in that period, is lost in the recollection of what was pleasing. The institutions and manners, as well as the scenes with which we were first familiar, seem to have been the most happy and perfect. Hence the reason why many are apt to say, though unwisely, as was remarked even by Solomon, "the former days were better than these." Sensibility has been blunted by age, imagination has faded, buoyancy of spirit is fled; we find nothing to compensate for the loss of past gratification arising from these sources, and we impute the change which so painfully affects us to the degeneracy of the age in which we live. Hence we judge unfavourably of our present comforts and enjoyments from the recollection of the scenes and pleasures of our youth. Long after the charming season of early attachments is past and gone, the memory of it is recalled with a glow of rapture that can never cease to be delightful. Even when the sunshine of life is shedding its last rays around the summit of accumulated years, the recollection of those beauteous forms, and gay delusive dreams, which youth formerly created, recals for a moment those tender and charming emotions. They make us thus think that, among all the gay scenes and pleasures with which we are now surrounded, there is nothing worthy of being once compared with those of our early days, which can never return.

Nearly allied to this class of prejudices are those of *education*. Children instinctively love their parents, and this affection is cherished by all the kindnesses they experience during their state of dependance, as they are taught to walk and to speak by their parents, so also to think and to judge ere they are capable of examining any subject for themselves. Their first opinions and sentiments are necessarily derived from others, usually from their parents and such teachers as their parents select for them. Not to mention the unbounded confidence they are accustomed to place in all around them, while unacquainted with the ways and wiles of the world, this implicit submission to authority, so indispensable in their situation, connected with love to their parents, respect for their teachers, and gratitude to every one who contributes to enlarge the sphere of their ideas, is apt to rivet upon them the first doctrines they have received, and to generate a habit of taking things upon trust, yielding themselves up in future life to every claim of superior talents or information. It is not easy to suffer the edifice which has been reared, so fair and captivating, in the process of education, to be demolished or even altered; and therefore, when doubts arise that would lead to investigation, they are apt to be hastily discarded; when new systems are proposed, they are forthwith disparaged or opposed.

*Implicit submission to authority* may be viewed still more generally as a source of prejudice. Nothing has tended more effectually to impede the progress of knowledge than respect for great names, and especially for the founders of systems. How eminent might the philosophy of Greece have become, had not the jarring opinions of those who assumed the character of leaders found such strenuous defenders in the followers of each. The Eclectic sect, who seemed to proceed on the principle of "proving all things, and holding fast that which was good," were certainly in the fairest way for attaining just views both of truth and morals. Never can the rule be too strictly observed, *nullius in verba jurare magistri*,—to "call no man master on earth," and to receive nothing as divine without the most satisfactory evidence.

Allied to the above is *veneration for antiquity*, which is apt to exert a wonderful influence over the mind. With many it seems to be a species of sacrilege to interfere with any thing,—whether opinion, institution, usage, or edifice,—which has been consecrated by time. The very uncouthness of an antique medal or coin, the harsh and unpolished strains of an old poem, present to the eyes of some an aspect of beauty to be admired and imitated, though neither good taste nor common sense be able to perceive it. There are some who will scarcely permit the slightest criticism on an ancient monument, whatever be its merits or defects. Ancient writers, too, particularly those who are styled the fathers of the church, are apt to be arrayed in the garb of such a venerable character, that the validity of their opinions must not be disputed, though they lived in darker ages than our own, and were perhaps younger than ourselves when their works were published. Right reason will appeal to antiquity for many obviously appropriate purposes, but never for a proof of the soundness of a sentiment or the excellence of a custom.

As a further and most fruitful source of prejudices, we may connect *local attachments with party-spirit*. In the wise ordinations of Providence, the inhabitants of a country are usually satisfied with its site, soil, climate, and productions, and learn to prefer these to those of every other nation. The inhabitant of the Alps loves his mountains, and would not exchange them for the fertile plains of Italy. The fishermen of Naples even boast of the burning mountain which enables them to follow their employment during the darkness of the night. This attachment to the natural scenery of our native country extends itself also to the political constitution and laws under which we have enjoyed all or the greater part of the pleasures we have ever experienced, and to the state of society and manners from which a large proportion of these pleasures has been derived. On this the idea and feelings of patriotism are founded. We may be right in preferring our own country to every other; but if we regard it as superior in its constitution, inhabitants, and productions, solely because it is our own, we proceed on a principle which cannot possibly guarantee us against error; and if we be right, others, judging on the same principle of the countries where they reside, must necessarily be wrong. The same rule will apply to the spirit of party. It would be foolish to adopt any system, scientific, political, or religious, without due investigation. But to conceive that we are forthwith pledged to resist every project of improvement, or prosecute every measure which the abettors of that system may adopt, and especially to look with an unfavourable eye on all who embrace not our own views, is to act under the influence of the most baleful prejudice.

*The love of the marvellous*, which must be traced to the powers of imagination over reason, may next be remarked as another source of rash and erroneous judgment. From this propensity of our mind arises a strong prejudice in favour of all wonderful recitals, whether by historians, travellers, or poets. The very excitement produced by these,—and by what affects us still more powerfully, stories of apparitions, prophetical dreams, visions, and magical operations,—is apt to predispose us to believe them, if it be not, in fact, connected with a secret belief of their truth. The last is now generally disclaimed, but the difficulty with which it is rejected by the judgment is still evident in the power which all such recitals afterwards retain over the fancy. The similarity they bear to the accredited accounts of supernatural intercourse with men in the Scriptures, has so impressed many religious persons with a persuasion of their truth, that they regard it as even a species of infidelity to doubt or deny them.

The prejudice in favour of *tradition*, of which the Romish church has taken full advantage, may, in some measure, be ascribed to all the principles already stated, but owes its power chiefly to the love of the *marvellous*. Nothing so delights us in youth as wonderful legends. We submit our minds to the narrator, unwilling to mar the pleasure they afford us by scrutinizing their verity, or so much as reasoning about them. The remoteness of the periods to which they refer invests them with an air of grandeur. They seem to possess the authority claimed by age. Whatever, indeed, has triumphed over the ravages of time, is apt, on that very account, and abstracting altogether from its intrinsic merits, to be regarded as entitled to peculiar respect. Even in our estimate of real life, the love of the marvellous often precludes the sober decisions of reason. The achievements of a hero, or romantic incidents in the history of an adventurer, often gain our admiration and esteem, in preference to the mild virtues and discriminating wisdom of the most illustrious statesman or legislator.

*Mental indolence, or the love of ease,* next demands our attention, as both the source and the confirmation of many false and erroneous judgments. We may be willing to be satisfied without the trouble of investigation, and to be spared the toils of research in forming our system. If, on the other hand, we have settled our views, as the result of what we deemed sufficient examination, we do not wish the repose we have attained to be disturbed. New ideas which cannot be referred to any part of our system, or seem to be in manifest collision with long established principles, occasion uneasiness and labour to him who has laid aside the habit of analysing his thoughts, and are therefore apt to be disliked or rejected without further inquiry. In proportion, too, to the influence which prejudice has gained over us in any of the forms already noticed, the habit and the power of reflection have been weakened and suppressed.

Among the sources of prejudice, *antipathy,* whether of the constitutional kind, which some suppose to be inexplicable, or only excited by occurrences, ought not to be overlooked. It contemplates its object in the most unfavourable light, shuts out from view all that is commendatory, puts the worst construction on every incident, and even suggests revolting ideas which have no foundation in truth. But antipathy is not the only species of sensibility which precludes the calm exercise of judgment; and therefore *sympathy* and other powerful emotions have, by a late theorist, been classed with it under the general head of the *prejudices of sensibility.* Our partiality for painful emotions, he alleges, is not entirely affected; it is often the true source of our actions, and the natural tendency of our thoughts. We are formed for sympathy; and sympathy, when applied to persons and not to things, not to the principles of moral conduct, is the most amiable of all our prejudices. It prompts us to undertake the cause and espouse the defence of whoever is in distress, or is unfortunate or oppressed. It promotes also our own happiness in proportion as it contributes to the welfare of others. This feeling, however, though apparently well directed, often misleads our judgment, and inspires us with prepossessions in favour of individuals which investigation and experience do not justify; but it is better, in most cases, to have been deceived than to have doubted and mistrusted. But sympathy extends its influence beyond its proper sphere when it induces a predilection for the opinions of the unfortunate, or leads us to excuse their immoralities. This is one of the greatest dangers of theatrical representation. From the propensity of our minds, indeed, arises a prejudice almost universal in favour of sorrow and suffering. A recital even of facts, which disquiets and rouses us, is already, in our estimation, half proved; a fear which renders us unhappy is already half realized.

The last sort of prejudice we shall mention is a certain *constitutional or acquired cast or turn of mind.* The power of abstraction belongs to every mind, but those in whom it predominates are liable to various errors. Influenced in their search after truth by this unhappy tendency, they feel inclined to consider their abstractions as real beings, as when theologians conceive the attributes of the Deity to be separate from his essence. They are apt to rest satisfied with general observations, or to imagine that when they have a general knowledge of a subject they understand it completely. They often think of individuals as possessed only of the qualities which belong to the genus. Imagination, again, is modified by habit and passion or the constitutional propensities. Those ideas to which we have long been accustomed seem to have wrought a track for themselves, by which they obtain easy admission in all cases. They are apt to give every subject a peculiar aspect, according to the ruling propensity of the individual. He wonders that others do not see it in the same aspect, and questions the rectitude of their judgment. The imagination of one in a sorrowful mood suggests melancholy pictures, and walks in a dreary path. To that of the joyous the same scenes appear gay and sufficiently stored with sources of pleasure. Further, as the habit of judging by *experience* is early acquired, and found to be a sure guide in most of the concerns of life, we are ready to resort to it on subjects entirely out of its sphere, as in judging of the history of other times and other countries, or investigating the evidence of miracles. The transferring, in a word, of that kind of evidence for which we have acquired a predilection, into subjects foreign to its nature, is a fruitless source of scepticism and error. The geometrician ought not to expect that the proof of moral principles, of the facts and doctrines of religion, or of the truth of revelation, must be conducted mathematically, or else be considered as entitled to no regard; nor ought divines and moralists, by attempting such proof, to do injustice to the systems they respectively hold.

PRELATE, an ecclesiastic raised to some place of eminence in the church, as patriarchs, archbishops, bishops, &c.

PREMISES, in law, signifies the lands, tenements, &c. mentioned in the beginning of a deed.

PREPARATIONS, in anatomy, parts of animal bodies prepared and preserved for anatomical purposes. Thus, in order to enable him to trace the various ramifications of the vessels of the body, the anatomist injects into them warm fluids of various kinds, as mixtures of wax, rosin, tallow, &c.; these becoming hard when cold, render the course of the vessels apparent. Preparations, when dried and varnished, are very durable.

PREROGATIVE, from *præ* and *rogo,* a peculiar privilege, or something that can be demanded in preference to all others. When applied to the king, it is called Royal Prerogative, and means that special pre-eminence above all other men which is conceded to him as a part of his regal dignity. The law ascribes to the king, in his supreme political character, certain attributes of a very high and dignified nature, in order to procure him reverence among his subjects, and these rights he enjoys alone, and not in common with any of his subjects,—such as the right of making war or peace, creating peers, and sending ambassadors.

These prerogatives are of three kinds, his royal *character or dignity*, his royal *power or authority*, and lastly his royal *income*. The law ascribes to the king, in his high political character, certain attributes of a great and transcendant nature, to induce his subjects to view him in the light of a superior being, that they may pay him that awful respect which will enable him the more easily to carry on the concerns of his government. As king, therefore, the law ascribes to him *pre-eminency* or *sovereignty*, whose authority as supreme magistrate is only bounded by the laws of God and the state. *In his political capacity*, therefore, the king "*can do no wrong*;" and Sir W. Blackstone observes that he is not only incapable of *doing* wrong, but even of *thinking* wrong;—as he can never be supposed to do an unwise or injurious action, he can never mean to do any thing improper. If any imputation or inadvertency were charged on the will of the prince, it might tend to lessen him in the estimation of his subjects. In the eye of the law, the king never dies, the kingship or imperial dignity, upon the decease of the reigning prince, being immediately vested in his heir or successor, so that his natural dissolution is generally called his *demise, demissio regis, vel coronæ,* signifying merely a transfer of property. *In respect of power and authority*, the king of England is not only the chief but the sole magistrate of the nation, all others acting by commission from him; and in this capacity he is so far absolute, that there is no legal authority that can delay or resist him. He may therefore coin what money, create what peers, make what treaties, reject what bills, pardon what offences he pleases, unless where the constitution has expressly bounded his authority. If, in the exercise of these prerogatives, any thing should be effected to the grievance or dishonour of the nation, the parliament would call his advisers to a severe and just account; but according to the forms of the constitution, in the exercise of these prerogatives which the law has given him, the king is irresistible and absolute.

*In his intercourse with foreign nations* the king is considered as the delegate or representative of his people, and what is done by the royal authority is the act of the whole nation; whereas any thing done without his authority is only the act of private men. Should his subjects, therefore, make war with a sovereign in league with England, without the royal assent, such war could not be considered as any violation of the league. *In domestic concerns*, the king maintains a great variety of characters. Being himself a constituent part of the legislative power, he is not bound by any act of parliament, unless specially named in it, so that the words person or persons cannot in the least affect him. His strength as a part of the executive power cannot be curtailed without his special consent, but he may take the benefit of any particular act although not specially named in it. Within the kingdom he is likewise *generalissimo*, or as the *first in military command*, and in this capacity has the sole power of raising and regulating fleets and armies, and likewise of erecting, manning, and governing forts and other places of strength within the kingdom. To the king also belongs the power of erecting light-houses, beacons, and sea-marks, for guiding and preserving vessels at sea by night as well as by day. In *domestic concerns*, the king is the fountain of justice, and general conservator of the peace, also the fountain or parent of honour, of office, and of privilege, and grand arbiter of domestic commerce for the regulation of weights, measures, and money; and in England he is the head and supreme governor of the national church. In virtue of this authority, granted by statues 8 of Henry VI., 1 of Eliz., 25 and 26 of Henry VII., his Majesty convenes, prorogues, restrains, regulates, and dissolves all ecclesiastical synods or convocations; and from this prerogative, also, arises the king's right of nomination to vacant bishoprics, and other ecclesiastical preferments. The ecclesiastical synod is the miniature of a parliament, in which the archbishop presides in regal state, the upper house of bishops being like the House of Lords, the lower house composed of the representatives of the several dioceses resembling the House of Commons. From this prerogative, as being the head of the church, an appeal lies ultimately to him from the sentence of every ecclesiastical judge.

*As to the royal income, or revenue*, which the constitution has vested in the royal person for the maintenance of his power and dignity, it is of two kinds, either ordinary or extraordinary. In regard to the first of these, it may be observed that the greatest part of it is still in the hands of subjects, such as lords of manors, who frequently look upon it as their own absolute right, as they and their ancestors are and have been vested in it for ages, although in reality derived originally from grants of our ancient princes. Hence the king is entitled to a *corody*, or pension, that is, he has the privilege of sending one of his chaplains to be maintained by the bishop till the bishop promotes him to a benefice. He has likewise the custody of the temporalities of bishops, and holds, under an implied trust for the benefit of the clergy in general, all the tithes arising in extra-parochial places. He has likewise the first fruits and tenths of all spiritual preferments in the kingdom, the rents and profits of the demesnes lands of the crown, the profits of his military tenures, till abolished by Charles II., the profitable prerogative of pourveyance and pre-emption, also of forcibly impressing the carriages and horses of subjects for the conveyance of baggage, timber, and the like, the rents arising from wine licences, profits from forests, and fines levied for offences against the forest laws, fees due for setting the great seal to charters, original writs, and other forensic proceedings, the right to royal fish, which are whale and sturgeon thrown ashore or caught near the coast, rights arising from shipwrecks, royal mines, treasure-trove, waifs, estrays, and all goods in which no one else can claim a property. To his ordinary revenue also belong forfeitures of lands and goods for offences, escheats of lands happening upon the defect of heirs, and finally the custody of idiots and lunatics.

Such was the king's ordinary revenue, which in ancient times was very large, and capable of being increased to a magnitude truly formidable, since there are but few estates in the kingdom that have not at one time or other been vested in the hands of the king since the Norman conquest, by escheat, forfeiture, or otherwise. But this hereditary revenue having fallen into the hands of private subjects, and being now reduced almost to nothing, and the casual profits arising from other sources being likewise almost all of them alienated from the crown, other methods have been adopted to supply the deficiencies which constitute the king's *extraordinary revenue.* If every individual in the kingdom were to be stripped of such lands as formerly belonged to the crown, and subjected to the inconvenience of feudal tenures, purveyance, and pre-emption, and to resign all his Majesty's royal franchises of waifs or wrecks, and the like, he would sustain a greater loss than by paying his proportion of taxes for the support of the king and his government. In a free government, therefore, the total abolition of taxes would be productive of the most pernicious consequences; and it is infinitely better for the community at large that individuals, in order to have sufficient time to attend to their own affairs, should select a few men of talent and great acquirements to preside over public affairs; and hence it is just and reasonable for individuals to contribute a portion of their private gains for the purpose of supporting and rewarding those who preside over public affairs, and who protect them in the enjoyment of their respective properties. In this way the subject contributes only some part of his property, that he may be secured and protected in the enjoyment of what remains. Such extraordinary grants have at different times obtained the different names of *aids, subsidies, and supplies*, all which are granted and regulated by the Commons House of Parliament. In the late reigns, the produce of certain branches of the customs and excise, of the post-office, and duty on wine licenses, the revenues of the remaining crown lands, the profits from courts of justice, and also a clear annuity of L.120,000 in money, were settled on the king for life, for the maintenance of his household, and for the honour and dignity of his crown and government. His late Majesty spontaneously signified his consent to give up his hereditary and other revenues to be added to the aggregate fund, which is now charged with the whole annuity to the crown. But although this annuity has been augmented to L.900,000, yet the public, by this disinterested bounty, were gainers of upwards of L.100,000.

PREROGATIVE COURT, an English court established to try testamentary causes, when the deceased person has left *bona notabilia* within different dioceses. The probate of such wills is a prerogative of the archbishop of the province, by whom a judge is appointed, from whose sentence there lies an appeal to the king in Chancery, instead of the pope, as formerly.

PRESAGE. See AUGURY.

PRESBURG, or POSEN, the capital of the kingdom of Hungary, situate on the Danube, about 46 miles east from Vienna, and 75 from Buda. This ancient town is in a pleasant and salubrious situation, but is neither large nor well built. There is here a cathedral, dedicated to St Martin, in which the king is crowned. There are also one Lutheran and several Popish churches, a Jesuits college, and three convents; and in the suburbs, which are more handsome than the town itself, there are several more churches and convents, with two hospitals. On the 26th December 1805, the peace of Presburg, as it has been called, was signed here, between the French and Austrians.

PRESBYTER, from a Greek word signifying old, a priest or elder.

PRESBYTERIANS, a denomination of Protestants, so called from maintaining that the government of the church, appointed by the apostles, in the New Testament, was by presbyteries, composed of ministers and ruling elders, all of whom were possessed of equal powers. The Presbyterians have been known by different names at different periods of time. In consequence of their endeavours to obtain a farther reformation of the church in Britain, they were, by way of reproach, called Puritans, a name derived from the *Cathari*, or *Puritani* of the third century; and during the reigns of Elizabeth, James I. and the two Charleses, they suffered the most cruel persecutions.

They were distinguished from Independents and Episcopalians, by maintaining, that the government of the church belongs neither to the people nor to certain orders ascending in dignity and power, from priests up to archbishops or popes, but that it is vested in the elders or presbyters, who meet as occasion requires, in smaller or larger associations, denominated kirk-sessions, presbyteries, and synods, or general assemblies. Among them, parties have the privilege of appeal from the inferior to the superior courts, which is precluded by the Independent and Congregational scheme. The power exercised by these courts is not merely consultative but judicial. And the idea of the unity of the church is preserved and rendered conspicuous in the subjection of all its departments to the superintendence and decisions of a supreme council. Those who contend that the original constitution of the Christian church was Presbyterian, allege that any appearance of independency in the primitive age was entirely owing to circumstances, particularly the distance of newly planted churches from one another, and the disadvantages under which they laboured. If the meeting of presbyteries, synods, or larger assemblies of church rulers was less practicable it was also less needful, since the superintendence of the apostles preserved the idea of unity, and their decision was final as to any litigated point. But the form designed to be permanent, it is said, was exemplified under the sanction of these extraordinary rulers, in such meetings of presbytery as that in which Timothy was ordained, 1. Tim. iv. 14; in the superintendence of several congregations by one consistory, as at Jerusalem, Ephesus, &c.: and in such a council as that which is described Acts xv. where certain decrees were enacted by the apostles and elders. Bishops, in the Episcopalian plan, are ecclesiastical officers, superior to preaching presbyters or elders, who have the government of a diocese, or district, including a number of congregations. The divine right of Episcopacy has been surrendered by Paley and other advocates of this plan of government in the Church of England. The ground on which they rest the defence of Episcopacy is the propriety of accommodating the different orders of the church to those of civil society. Presbyterians, for the most part, hold the divine right of their system, and allege that the purity of those who, in our translation, are sometimes styled bishops, and their identity with presbyters or elders, are sufficiently established by comparing the epistles to Timothy and Titus, 1. Tim. iii. 1—5, Tit. i. 5, 6, 7. They remark, too, that the word rendered *overseer*, and applied to elders, is in the original *bishop*,—Acts, xx. 28. And that in the church at Philippi there were a number of bishops, who, consequently, could not be diocesan, Phil. i. 1.

Episcopacy, it is granted on all hands, soon gained ground in the church, and gradually assumed that form which is displayed in the Catholic body, when the bishop of Rome was, in A. D. 533, declared supreme head of the church on earth. The separatists generally retained the Presbyterian plan, and acted upon it as far as their circumstances would permit. Their elders were possessed of judicative power, and some of them preached. Nor was the original principle of Presbyterianism altogether relinquished, even in the Catholic church, since all questions of importance were determined in councils, some of which were general. Many of the friends of the reformation in Britain were compelled, by the cruelties of Mary I. to fly to the Continent. Those who were at first called Puritans, as their opponents were styled Conformists, established congregations at Basil and Geneva, where the Presbyterian form of government was exercised. Under the influence of Calvin, it became general in the reformed churches. By Knox and the Melvilles it was successfully introduced into Scotland, and became the form of government in the church established by law. It is retained by the churches of the secession, who are distinguished by this, among other circumstances, from the several bodies of dissenters. The first Presbyterian church in England was erected at Wandsworth, a village near London, and on the 20th of November 1572, eleven elders were chosen and their offices described in a register entitled the Order of Wandsworth. Notwithstanding proclamations for uniformity, churches on this plan were soon erected in other counties, though with the utmost privacy. Their history from that time leads us through many details of persecution and triumph. No class of men understood that principle of liberty of conscience better than they, or stated it more clearly when they themselves were subjected to suffering; but it is to be regretted that they did not duly respect this principle when possessed of power, and, that they cannot, therefore, be freed from the charge of being influenced by that persecuting spirit of which they themselves so much complained. (See the article Non-conformists.)

Though the toleration granted by Oliver Cromwell extended to all sects and religious communities, yet the Presbyterians and Independents were treated with peculiar marks of favour. A little after his elevation, it was resolved by Parliament, at the conclusion of a debate concerning public-worship and church-government, that the Presbyterian form should be established. At the same time Cromwell, though attached to no particular sect himself, gave the Independents extraordinary proofs of his goodwill, and augmented their credit and authority, as the easiest and least exasperating method of keeping the Presbyterians in check, whom he regarded as ambitious of high ecclesiastical power. When Richard Cromwell resigned the protectorate, their sufferings recommenced. Although they had effected the restoration of Charles II. and had saved from the cruelty of the Independents the life of his predecessor, yet were their expectations respecting the establishment of a Presbyterian government entirely frustrated. The king himself deceived them; for when he came to his palace at Whitehall, ten of the Presbyterian clergy were appointed his chaplains, yet, before the expiration of the year 1660, numbers of the parochial clergy were prosecuted for not using the book of common prayer, it being alleged by the justices that the laws returned and were restored with the king. Some hundreds of the Presbyterian clergy were at once dispossessed by the restoration of the Episcopalians to their former livings, and, in short, the Church of England resumed its lost power, and all its ancient dignity, the peerage of the bishops alone excepted. If the nation was before this period overwhelmed with enthusiasm and bigotry, it now became completely deluged by licentiousness and profligacy. A torrent of vice and irreligion, issuing from the court, overpowered the virtues of the Puritans, and ruined the morals of the people. The restored bishops, still smarting under the privations they had experienced, breathed out their vindictive spirit in every possible way against the unhappy people, and the virtues of the Puritans were forgotten and despised. The religious ceremonies of the Episcopalians were revived; and what was calculated to exasperate the Presbyterians more, there was exhibited in their external devotions an evident tendency towards popery. Mr Neale, a writer on this subject, therefore observes: "To appear serious, to make a conscience of one's words and actions, was the way to be avoided as a schismatic or a sectarian. They who did not applaud the revived ceremonies were marked out for Presbyterians, and every Presbyterian was a rebel." The press teemed with publications enforcing the doctrines of passive obedience and non-resistance; and an open and flagrant persecution at length commenced against the Presbyterians, which daily became more violent, till the act of uniformity, which began to be in force on St Bartholomew's day in 1662, completed the triumph of Episcopacy. In consequence of the operation of this act, upwards of 2000 of the most worthy and most learned men of the age were ejected from their benefices, and were loaded with every kind of insult, privation, and distress. Thus were they to whom the king was indebted for his restoration to the throne of England, rewarded by the hypocritical Charles, and deceived by his commander General Monk. Nothing remained for the Presbyterians now to hope for, unless from the king's private attachment to the Ro-

Presbyterians.

Presbyterians.

man catholics, and from what is called his dispensing power, or the exercise of that illegal authority by which civil liberty might one day be destroyed. This in effect enabled the sovereign to dispense with the execution of the established law, created a power above law, and made him an absolute monarch. To endanger the liberties of their country by countenancing the exercise of this usurpation, or to unite themselves with the Roman Catholics, was indeed a painful alternative to the Presbyterians. When this dispensing power, under the artifice of universal toleration, was resorted to in the succeeding reign, in order to betray the Protestant interests, the Presbyterians in the most disinterested manner declined the acceptance of any toleration for themselves, which might either endanger the true religion or encourage the popish errors and superstition which had so frequently deluged their country with blood.

The calamitous fire which happened in London in 1666 somewhat abated the spirit of bigotry and persecution; and the despised Presbyterians were, for a time, overlooked, or permitted to live in peace. During this period, which lasted only two years, they built tabernacles or tents of wood, in which they preached; and their places of worship were numerously attended with serious and penitent people. But the vindictive spirit of persecution again revived as soon as the humiliating calamity of the memorable fire began to be forgotten. The Presbyterians were no longer suffered to meet for public worship, and their private assemblies were dissolved. Great numbers of violent publications were issued from the press against them; and amongst those the most bitter were written by Drs Patrick and Parker, both of whom were afterwards rewarded by their elevation to the rank of bishops, although the latter met with a very able but sarcastic reply from the famous Andrew Marvel. About two years after this period, the Presbyterians were again subjected to the most distressing and vexatious persecution, by the revival of the conventicle act.

Various penal statutes were passed against the Protestant dissenters in England, the last of which was the test act, in 1673, which declares, that every person in office or employment shall "receive the sacraments in some parish church before competent witnesses," shall take the oaths of supremacy and of allegiance, and subscribe a declaration renouncing all belief of the real presence in the eucharist. Since that period various unsuccessful attempts have been made in different parliaments for a toleration of the dissenters, and many books and arguments have been published in their defence, but all without the desired effect; and the Presbyterians still continued under the same hardships and disabilities till the death of the king, which happened in February 1685; and with him terminated all hopes of redress and relief on the part of the English dissenters. During his last moments he received the sacrament and absolution at the hands of a priest, and he died in communion with the church of Rome. To this prince succeeded his brother, James Duke of York, who, with his queen, was crowned the same year, in April. Disclaiming all arbitrary principles, he commenced his reign, by declaring that he would support and maintain the religion as by law established. By this it was soon understood that he had resolved to support the doctrines of passive obedience and non-resistance, and to tolerate the principles of the Roman Catholics, supposing that in doing so he was justified by the articles of the Church of England; and to this he was encouraged by the Jesuits, by whose counsel he suffered himself to be almost wholly directed.

The dissenters feeling themselves not justified in trusting to the plausible pretences of James II. saw it more conducive to the peace of the nation and their own interest to join with their opponents of the established church; and, like good Christians, they generously gave up their private animosities and resentment, satisfied that, by so doing, they adopted the most effectual means of obstructing the progress of Popery, and preserving civil and religious liberty. No line of conduct could be more wise than that adopted by the dissenters; and it was by this means alone that they saved both church and state,—as it was evident that the free toleration granted by James, and the dispensing power which he possessed, would, in time, become the principal engines of their destruction. All prosecution of the Protestant dissenters by the penal laws was thus rendered unnecessary, although the laws still continued in full force, and were not legally repealed till after the revolution in 1688. This great event produced a mighty change in the condition of the whole body of the Protestant dissenters, who, before this happy period, were almost sunk into despair. After the abdication of the throne by James it was filled by William and Mary, who were favourable to the Protestant cause, as well as to toleration and liberty of conscience; so that his majesty, by his great prudence and moderation, succeeded in softening the rigours and abating the violence of national prejudice against the Protestant dissenters. Since that happy period of our national history nothing remarkable has occurred; for although the corporation and and test acts be still unrepealed, the Parliament of Great Britain has adopted such wise precautions as totally to divest these statutes of any thing like an oppressive nature; so that their inconvenience is nearly as little felt as if they had never been in existence. Between the Episcopalians and Protestants there is now no subject of dispute; and although these two religions may differ in point of external form, they are substantially the same in effect; consequently there can be nothing to divide the interests of the people, or prevent them from exercising towards each other mutual benevolence and charity.

The Presbyterians in England continue to be one of the most learned and most respectable sects of Protestant dissenters, and have long since abandoned those gloomy, severe, and rigid maxims for which their predecessors were so remarkable. Their religious tenets are impartially described in "An Abstract of a Profession of Faith made at a Public Ordination at the Old Jewry, in 1756;" likewise in some *Questions proposed to the Rev. Thomas Wright, at his Ordination, May* 1759, with answers thereto. These tracts will be found in the "*History of Religion*," an anonymous publication, in 4 vols. 8vo. 1764. Of their religious tenets it may be sufficient here merely to observe, that, with the Presbyterians of Scotland, they maintain that the government of the church, as appointed in the New Testament, is by presbyters, and they acknowledge no head of the church but Jesus Christ. They also acknowledge the unity and equality of three persons in the Godhead; but a great number of the English Presbyterians are Unitarians, either Socinians or Arians. They acknowledge the authority of divine revelation and its sufficiency to salvation, but deny original sin, believing that all corruption and moral depravity are contracted and not original. In general they are Pædobaptists, and reject the doctrine of predestination with several other tenets connected with it, and admit that the sacrament of the Lord's supper, as Dr Watts says, is eating bread and drinking wine in the church in remembrance of the death of Christ. Whatever may be the religious opinions of the English Presbyterians in our day, it appears that, in former times, they were purely Calvinistic. This is abundantly obvious from the Lambeth articles proposed by the Calvinistic Puritans to be added to the 39 articles of the church of England, but which were rejected by Queen Elizabeth and suppressed. They form, however, the ground-work of Calvinistic doctrine, as may be seen from the nine following articles:

No. 1. God from eternity hath predestinated certain men unto life; certain men he hath reprobated.

2. The moving or efficient cause of predestination unto life is not the foresight of faith, or of perseverance, or of good works, or of any thing that is in the person predestinated, but only the good-will and pleasure of God.

3. There is predetermined a certain number of the predestinate, which can neither be augmented nor diminished.

4. Those who are not predestinated to salvation, shall be necessarily damned for their sins.

5. A true, living, and justifying faith, and the spirit of God justifying, is not extinguished, falleth not away, it vanisheth not away in the elect either finally or totally.

6. A man truly faithful, that is, such a one who is endued with a justifying faith, is certain, with the full assurance of faith, of the remission of his sins, and of his everlasting salvation by Christ.

7. Saving grace is not given, is not granted, is not communicated to all men, by which they may be saved if they will.

8. No man can come unto Christ unless it shall be given unto him, and unless the Father shall draw him; and all men are not drawn by the Father, that they may come to the Son.

9. It is not in the will or power of every one to be saved.

A copy of these articles may be found in Fuller's Church History, and in Collier; in Bowman's Review of the Doctrine of the Reformers, and in the Antijacobin Review, Vol. XVIII. p. 357. These articles, in the reign of James I. by the management of Archbishop Usher, a Calvinist, were incorporated into the articles of the church of Ireland, but were rejected in 1634, when the articles of the church of England were received as those of the church of Ireland.

The doctrines and tenets of the Presbyterians in Scotland are likewise Calvinistic. They are contained at large in the Westminster Confession of Faith, to which the reader is referred. As they are agreeable to the confessions of most other Protestant churches, they do not materially differ from the 39 articles of the Church of England. The mode of worship in the established church of Scotland is extremely simple and solemn. A portion of a psalm or hymn is sung by the congregation, having been previously read aloud by the minister, after which he offers an extempore prayer to God while the people stand. He next reads a portion of Scripture, usually a chapter, out of the Old or New Testament, then delivers a discourse, when he again prays; and the service is concluded by the people singing psalms and the minister pronouncing the blessing. The whole of this duty is usually performed in less than two hours, and the afternoon service is the same.

As to the constitution of the church of Scotland, little more is necessary to be said, after what has been already stated. We may however observe, that the Presbyterians of Scotland consider the authority of their minister, to preach the gospel and administer the sacraments, as derived from the Holy Ghost by the imposition of the hands of the presbytery. They object to the scheme of the Independents in respect to the common rights of Christians to preach or conduct public worship, upon the same grounds as do the Episcopalians. They consider no order in the church, as established by Christ and his apostles, superior to that of presbytery, and assert that all ministers, being ambassadors of Christ, are equal in virtue of their commission; that presbyter and bishop are of the same import, and are only two names for the same church-officer; that prelacy was established upon the primitive practice of making the moderator, or president of the presbytery, a permanent officer. Every one knows that, from the reformation till the revolution, a constant struggle was maintained between the court and the people for the establishment of an Episcopal or a Presbyterian form of church government. On account of the support which it gave to the prerogatives of the crown, the house of Stuart patronised the former, but the latter was preferred by the great majority of the people, chiefly, perhaps, because the people or laity are mixed with the clergy in church judicatories. In the Presbyterian church every regulation respecting public worship, discipline, or ecclesiastical censure, which in the Episcopal church emanates from a diocesan bishop, or the authority of a convocation of the clergy, is the enactment of both clergy and laity, who are vested with equal powers, and who determine every question that comes before them by a plurality of voices. Those who, besides the clergy, belong to this ecclesiastical court, are called *ruling elders*. In every parish in Scotland there are several of these lay elders, chosen generally from the heads of families, and who are grave and serious persons, exemplary in their deportment, and who have been set apart to their office by solemn prayer, called ordination, when both elders and people are seriously exhorted to fidelity and diligence in their respective duties. The lowest ecclesiastical judicatory, which is composed of these elders of the congregation and the minister, is called the kirk-session, of which the minister is *ex officio* moderator or president, but has no negative voice over their decisions, nor any right to vote at all unless when the votes of the elders are equal. Against their sentence, however, he may protest and appeal to his presbytery; and the same privilege belongs to every elder, as well as to every person who may think himself aggrieved by their proceedings. Another class of persons, called deacons, whose office is to take care of the poor, may likewise be present in all deliberations of the session; but although they may offer their counsel on any question that may come under consideration, they have no vote excepting in what relates to the giving of alms.

The next ecclesiastical court of Scotland is the presbytery, composed of ministers within a certain district, and a ruling elder from each parish, who is chosen every six months. This court is designed for examining, admitting, ordaining, and censuring ministers,—admitting to trial students and probationers for the ministry, and for deciding upon all references that may come by appeals from kirk-sessions within the bounds of its jurisdiction; and from their sentence those aggrieved may appeal to the *provincial synod,* which exercises jurisdiction over certain bounds, and meets generally twice in the year. But the highest court of ecclesiastical authority in Scotland is the General Assembly, consisting of a certain number of ministers and ruling elders from each presbytery, and of commissioners from royal burghs and universities. There are in Scotland 15 synods, consisting of members from 78 presbyteries. Presbyteries of less than 12 parishes send two ministers and one ruling elder, from 12 to 18 send three ministers and one elder, from 18 to 24 send four ministers and two ruling elders, and if they contain 24 ministers they send five ministers and two elders. Every university sends one commissioner to represent its own body, and every royal burgh sends one, and Edinburgh sends two, and their elections must be attested by the kirk-sessions of their respective bounds. These commissioners and ruling elders must be elected six weeks annually before the meeting of Assembly, and are frequently men of the first rank and talent in the kingdom. The Assembly meets once a-year, about the middle of May, and sits ten free days. In a civil capacity the king presides in this Assembly, and is represented by his commissioner, who is always a nobleman, but takes no part in the deliberations. The moderator presides as speaker of the house, and is chosen from among the ministers. On the tenth day of the Assembly it is dissolved by the commissioner, as to its civil capacity, in the name of the king, and by the moderator, as to its spiritual jurisdiction, in the name of the Lord Jesus Christ, as the head of his church. In questions purely religious, the determination of the Assembly is final; and it takes under its cognizance all appeals from every ecclesiastical court in Scotland.

PRESCIENCE, in theology, foreknowledge; that knowledge which God has of every thing future, upon which the doctrine of predestination is founded. See PREDESTINATION.

PRESCOT, a market town and county-palatine of Lancashire. See LANCASHIRE.

PRESCRIPTION, in law, a right or title to any thing grounded upon a continued possession of it beyond the memory of man. This right is acknowledged by law; it being presumed, that nothing contrary to right, or injurious to another, would be allowed to remain unchallenged for so long a period.

PRESCRIPTION, in medicine, a form of direction for the mixing up of some compound medicine.

PRESENTATION, in ecclesiastical law,—see PATRONAGE.

PRESENTATION of the Virgin, a feast celebrated by the church of Rome on the 21st of November, in memory of the holy Virgin's being presented in the Temple by her parents for dedication. Some suppose this festival to have been instituted among the Greeks about the 11th century. Gregory XI. is said to have established it in the West in the year 1732.

PRESENTATION of our Lady, the denomination of three orders of nuns. The first was proposed in 1618, by a maid named Joan of Cambray, but was never established. Nicholas Sanguin, bishop of Senlis, established the second in France, in the year 1627; and the third was established in 1664, by Frederic Borromeo, at the request of some devout maids at Morbegno, who entreated him to grant them the privilege of living in community in some retired place. He accordingly erected them into a sisterhood under the title of Congregation of Our Lady.

PRESENTMENT, in law, usually comprehends, not only presentments properly so called, but also inquisitions of office, and indictments by a grand jury. A presentment, properly so called, is the notice of any offence which a grand jury takes from their own knowledge or observation, without any bill of indictment laid before them at the suit of the king; and upon this notice the officer of the court must afterwards frame an indictment before the party presented can be put to answer it. Inquisitions of office are acts of a jury, summoned by the proper officer, to inquire concerning matters relating to the crown upon evidence laid before them. Some of these inquisitions are in themselves convictions, and cannot afterwards be traversed or denied, others may be afterwards examined and traversed.

PRESERVATIVE PHIAL, by Guyton Morveau, a chemist of France, in order to prevent the spreading of contagion. It is prepared as follows: Having provided a strong glass phial, capable of containing at least thrice the quantity of the following mixture, with an accurately ground stopper, put into it about forty or fifty grains of the black oxide of manganese, broken into coarse powder; then add about two drachm measures of nitric acid, and an equal quantity of muriatic acid. The phial must then be stopped up, and, in going into infected rooms, having previously averted the head, a small portion of the gas must be allowed to escape.

PRESERVES, LIFE. See BOAT, LIFE, FIRE-ESCAPES, and SHIPWRECK.

PRESS, LIBERTY OF. See LIBERTY OF THE PRESS.

PRESS, from *prelum*, is a machine of wood and iron, used by mechanics and other artificers for compressing any substance or body very close. Common presses usually consist of six pieces, namely, two smooth flat planks, between which is laid whatever is intended to be pressed; two screws or worms fixed to the lower plank, and passing through the holes in the upper; and two nuts, in form of an S, for the purpose of forcing the upper plank, which is moveable, against the lower, which is fixed. Presses generally made use of for *expressing liquors* are nearly the same with the common presses, only the under plank is perforated with a great number of holes for the juice to run through into a receiver or tub below. Others have only one screw or arbor passing through the middle of the moveable plank, which descends into a square box full of holes, through which the juices flow as the arbor turns.

*Presses, Cutting, used by bookbinders*, stationers, and others, consist of two large wooden cheeks, united by two long wooden screws, which being turned by an iron bar, set asunder or draw together the cheeks at pleasure, so as to fit them for the size of the books or paper to be cut. The cheeks are placed in a longitudinal direction, upon a stand resembling a chest, into which the cuttings fall. The plough, to which the cutting knife is fixed by a screw, moves upon the cheeks; and its knife, when it requires to be sharpened, is taken out by turning the screw with a key. The plough has a wooden screw, which brings the knife to the book or paper, which is fastened between two boards in the press. To keep the plough square and even on the cheeks, so that the knife may pare equally, the foot of the plough in which the knife is not fixed slides in a groove attached to one of the cheeks. The knife, which is thin, flat, and sharp, is about six inches in length, and terminates in a point like a lancet at the cutting end, while the other extremity is broad, the more easily to fasten it to the plough. As, in cutting books or papers that are very thick, the long knives are apt to jump, the Dutch make use of circular knives, which not only are more steady, but require less frequent grinding.

*Press serving to callender and gloss linens, silks*, &c. See CALLENDER.

*Press in coining*, a machine used in the striking of money. See COINING.

*Presses used by founders* have a strong square frame, made of four pieces of wood firmly united. They are of various sizes, and two of them are necessary for each mould, at the two extremities of which they are placed, so that the two parts of the mould in which the metal is to be run may be closely pressed together by wooden wedges driven between the mould and the sides of the press.

*Presses made use of by inlayers* resemble the former, excepting in so far as the pieces of wood are thicker, and only one of them moveable; the other, being in form like a tressel, is supported by two legs fixed into it at each end. This likewise answers another purpose,—that of sawing and cleaning the pieces of wood made use of in musquetry and inlaid work.

*Presses used by joiners*, for keeping close the pannels and pieces of wood that have been glued, are very simple, and consist of two piece of wood four or five inches square and two or three feet long, whereof the holes at the two ends serve for the nuts of the screws.

*Presses, Printing.* See the article PRINTING, and Plate 156.

*Press, Rolling*, is a machine used for taking off impressions of prints from copperplates. See the article PRINTING.

*Presses used by woollen manufacturers*, for smoothing cloths, serges, rateens, &c. and for giving them a gloss, are likewise formed of several pieces, consisting of the cheeks, the nut, and screw, with its bar for turning it round that it may descend perpendicularly on the middle of a wooden plank, beneath which are placed the stuffs to be pressed. Linens, silks, and other cloths, are rendered even and smooth by the operation they undergo in the callender, as already mentioned.

Several of the most useful presses for packing and for expressing oils and liquors, are represented in Plate 155, of which the following is a description:

Fig. 1. *Press for obtaining olive-oil.*—The olives must be first bruised under a mill-stone, in a rough trough, when they are put into the maye or trough *m*. *a a* are two cheeks or upright beams; *b* the female, and *c c* the male screw; *f* the board pressed by the screw; *g* a block of wood in form of a cube; *h* a circular board, called the peel, for being put under the block. All the liquor that can be expressed from the mashed olives, by turning the screw, is called virgin oil; and when no more can be obtained in this way, hot water is poured upon the remainder in the press, which then produces a coarser oil. Fig. 2. is a front elevation of Mr John Peak's improved *Packing-press*, for which he was rewarded with 30 guineas by the Society for the Encouragement of Arts, Manufactures, and Commerce. A A is the frame; B B the large screws, which are fixed and immoveable; C a circular bar of iron, having upon it two endless screws or worms, and extending beyond the sides of the press. These screws, E E, work in two teethed wheels fixed to the nuts, and the nuts and bed are moved up and down the screws as found necessary, by turning the winch D. The men who work the press stand upon a stage F, which is suspended from the bed, and a similar one might, if required, be fixed at the other end of the bar. Two pieces of strong wood, fastened together by screws and nuts passed through them, form the bed of this press, as shown at *h h h h*. This being a double press, much time is saved; because when the lower package is sufficiently pressed, another being laid on the upper side, begins to be pressed as the package below is relieved; and this may be done alternately during the whole operation. Fig. 3. of same plate represents a Screw-press, made use of for expressing oil. It is formed of one solid piece of cast iron, A D B, in the upper part of which is fixed a brass nut, in which the screw E is wrought,

Press.

Press || Pressing.

by a long lever, F, passing through its lower end. The materials from which the oil is to be expressed are placed under G, the bed of the press, with a hot iron plate between each bag, which is commonly composed of horse hair. After the screw has been turned as long as possible by men, the power of a windlass is next applied, by means of a rope hooked at the end of the lever, during which operations the oil oozes out of the bags and runs into H, the receiver placed below it. Fig. 4. is another press also used for expressing liquors. A B D is a strong wooden frame, through the upper bar of which, at D, passes a thick iron rack E, having teeth like a saw, into which is forced, by a spring, a small click *e*, to prevent it rising after being pressed down by the lever F. In the bed of the press, K ,is fixed the lower end of this rack, and under K are laid the goods to be pressed. The rack E passes through a mortice in the lever F, and, a click, *f*, which takes into its teeth the lever, moves round a bolt *g* as a centre, which can be put through any of the holes in the beam, as may be required, according to the quantity of goods to be pressed. When the lever F is raised, the click *f* moves over the sloping side of the teeth, and when depressed the click is pushed into the teeth, and forces the rack still farther down, when the click *e* holds it till the lever is again raised to take in another tooth. An improvement has been proposed in *Les Annales des Artes*, by M. Buschenderf, which is, that a bolt *h* be put through two of the beams, and a common handspike H put under it. Let this handspike be connected with F by an endless chain, having a hook at the end, so as to shorten or lengthen it by hooking it into another link, as may be required. Let a plate of iron *l*, with teeth in it, be fixed upon the lever F, and a long click I, connected with the frame, fall into them, so as to keep the lever down. The teeth of the rack may, by this means, be divided into four or five parts; so that, when the click *e* takes hold of a new tooth, the lever may again be raised by lifting up the long click I. This press may be used either with or without the chain and handspike, as they can easily be removed or replaced in a very short time.

Fig. 5. and 6. of Plate 155, represents the *Cyder-press* constructed by Mr Anstice, which consists of two pieces of wood 12 by 6 inches, and each of them 12 feet in length, laid parallel to each other at the distance of 12 inches, and fixed in that position by blocks laid between, and bolts passing through them. These beams, A A, Fig. 6. form the bed of the machine, and B B two uprights, 12 feet in length, and 6 by 8 inches, are morticed into them, and secured by iron squares and pins. C C also are two uprights, 6 by 10 inches, and 5 feet long, morticed and fixed in the same manner: the lever D, 12 by 13 inches, and 17 feet in length, turning on a strong bolt which passes through them, and also through iron straps, and a stirrup of iron which goes over the end of the lever, and makes the turning point, not through its middle, but in the line of its lower side. E, a lever 6 by 8 at one end, and tapering towards the other, is 20 feet long, and turns in a bolt at the upper extremity of the uprights B B. F, 1. 2. 3. 4. four oak planks 10 feet long, called needles, 4 by 2½, loosely morticed into the upper lever, to which they are hung by bolts, so as to swing and play perpendicularly in the mortice of the large lever. Through these needles are inch holes about an inch distant, and from the lower extremities as high as the great lever will reach. G, a bed for receiving whatever is to be pressed, and H a frame for supporting a winch, worked by a handle at I. At the extremity of the small lever are fixed two pulleys, the one below and the other above it. There is fastened to the ceiling, at K, a rope of about half an inch diameter; then passed through the upper pulley on the lever, and from thence to a block at L; and then going four turns round the winch, it is passed through the block under the lever, and is fixed to the machine at M; so that the winch being turned one way, raises the end of the small lever, but turned the other way it depresses it.

In working this press, an iron pin must be put into one of the holes in the needles, above the great lever which acts upon the substance to be pressed; and when the small lever is raised or depressed to its utmost limits, another pin is to be put into the hole nearest the great lever, on the other side of the uprights B B, so that the pressing goes on whatever way the winch is turned, and whether the lever rises or falls. When the needles farthest from the fulcrum of the small lever are used, the resistance is the least; but when those nearest are employed, the power of the machine is doubled. A weight of half a hundred is suspended for the purpose of gathering in the rope, which is liable to slack; after taking two turns round the winch it passes through a pulley, and then, taking two additional turns, it is carried through the other block; so that the weight remains without increasing the friction, as it counteracts the pressure upwards on its axis by hanging under the winch. This machine is extremely simple, and capable of being applied to many purposes besides the process of cyder-making. Its power, which is vastly great, is nearly as one to 1136, and is capable of farther increase to almost any extent. Instead of using ropes and pulleys for moving the lever E, an improvement has been suggested of a small wheel or pinion on the axis of the winch W, Fig. 5. with a strong beam *e n* from the lever, having, in the under part of it, an iron rack with teeth adapted to those in the pinion. The advantage supposed to be obtained by this alteration is a diminution of friction.

PRESSING, in the manufactures, is the rendering a cloth, stuff, &c. smooth and glossy, by means of pressure. There are two methods of pressing, namely, cold or hot. In the former method, the stuff, after having been properly cleaned, is folded in equal plaits, a sheet of pasteboard put between each plait, a wooden board placed above all, and in this manner it is put into the press, and compressed by means of a screw turned by a lever. The method of hot-pressing is this. The stuff, after being sprinkled with a little water, is prepared as for the cold-pressing, only between every sixth or seventh sheet of pasteboard, an iron or brass plate well heated is introduced. This method of pressing being intended to cover the defects of the stuffs, has been often prohibited.

PRESSURE, or PRESSION, in mechanics, the continued action of one body against another, tending to produce motion. In pressure a re-action is produced in the body acted upon equal to the force exerted by the body that presses. Thus, a weight must meet, from the body that supports it, a resistance equal to the momentum of its own gravity; so that in pressure both bodies are equally affected.

PRESSURE of the Air, the force with which any given column of the atmosphere presses upon bodies at or near the earth's surface. This pressure can be estimated either by an air-pump or barometer; and it is found, by experiment, that the mean pressure of the air on a square inch of the earth's surface is about $14\frac{4}{5}$ lb. Avoirdupois, so that if the surface of a man's body be 15 square feet, the pressure he must sustain from the atmosphere will be more than 14 tons. The pressure of the whole atmosphere on the surface of the earth is 11,522,211,494,201,773,089 pounds Avoirdupois. See Pneumatics.

Pressure of Water.—This fluid being supposed to be everywhere of the same density, its pressure is estimated by its density, and is the same in all directions. Upon a square foot of surface every foot in height of water presses with the weight of $62\frac{1}{2}$ pounds Avoirdupois. It was once generally believed by philosophers, that water could not be compressed when in a fluid state. To ascertain the truth of this, the philosophers of the academy del Cimento, at Florence, filled the cavity of a hollow globe of gold with water, and submitted it to the action of a very powerful press; and though drops were forced through the pores of the gold, yet no observable compression took place upon the water within. This experiment was, with some variations, repeated by Mr Canton, who found that water was capable of some compression. Mr Jacob Perkins lately prosecuted the inquiry farther, and by means of a machine of his own invention, called a pezonacter, which he filled with water, and submitted to a pressure equal to the weight of 326 atmospheres in a hydraulic press, found that the bulk of the water could be diminished by this pressure three and a half per cent. See Pneumatics.

PRESTER, or PRESBYTER, John, or Jean, a name given to an emperor of the Tartars, who was said to have embraced the Christian religion, and encouraged it among his people. The history of Prester John is involved in much obscurity; some having supposed him to have reigned in Abyssinia. This latter opinion took its rise from the following circumstances: In the fifteenth century, Pedro Couvilliano was employed by John II. king of Portugal, to enquire into the real situation of Prester John's dominions. Couvilliano, in prosecuting this enquiry, arrived in Abyssinia, and observing many resemblances in the emperor to the things reported in Europe concerning Prester John, he concluded he had accomplished the object of his research. His report gained credit in Europe, which being at that time in a state of great ignorance, errors and mis-statements of travellers were but little canvassed. However, from certain documents discovered in times of more active curiosity, the Portuguese account appears to be false, and has in general been abandoned. It is now nearly agreed upon by learned men, that Prester John reigned somewhere in Asia, though the exact situation of his kingdom is not known.

PRESTO, prefixed to a movement in music, intimates the most rapid measure of all the five degrees of quickness. *Peupresto* and *prestissimo* mark increased rapidity of this measure.

PRESTON, a town of Lancashire. See Lancashire.

PRETOR, or PRÆTOR, a Roman magistrate appointed for the administration of justice, and next in dignity to the consuls, in the absence of whom the government of the city was assumed by the *pretor urbanus,* whose duty it was to distribute justice amongst the citizens, there being another pretor, called *pretor peregrinus,* to judge between citizens and foreigners.

PRETORIAN GUARDS, a body of men kept in pay by the Roman emperors to awe the people and secure themselves upon the throne. These troops received double pay, and various other emoluments, in order to attach them to the person of the prince.

PRETORIUM, the hall where the pretor lived at Rome, and administered justice; also the tent of the Roman general, and a place in the city where the Pretorian guards were lodged.

PRETTIGAU, the name of one of the divisions of the Grisons in Switzerland. It comprehends the districts of Kloser, Castels, and Schiers; forms a valley eight leagues in length and four in breadth, and is well peopled. Prettigau is supposed to have been the territory of the Rucantii. In the district of Schiers are situated the once celebrated baths of Gavey.

PRIAM, the last of the Trojan kings, son of Laomedon. He first married Arisba, whom he divorced; and afterwards Hecuba, by whom, according to Homer, he had 19 children. After the loss of almost all his sons, he himself was barbarously murdered by Pyrrhus, son of Achilles, at the altar of Jupiter, during the night in which Troy was taken by the Greeks. This event is supposed to have happened 1184 years before the birth of Christ.

PRIAPUS, in heathen mythology, the son of Bacchus and Venus. He presided over gardens, in which his statue was usually placed to defend them from thieves and birds.

PRICE, Richard, celebrated for his moral and political works, was born at Tynton, in Glamorganshire, in 1723. His father, who was a dissenting minister, placed him under the care of able teachers in Wales, where he continued to prosecute his studies with a view to the ministry, till 1740, when, both his parents being dead, he removed to London, where he was received by his uncle the Rev. Samuel Price, a pastor with Dr Watts, and put to an academy of which Mr Eames was principal teacher. After four years, he went to live as domestic chaplain in the family of Mr Streatfield of Stoke-Newington, at the same time regularly assisting Dr Chandler at the Old Jewry. In 1757, Mr Price was chosen minister at Newington-green, whither he went to reside, having married shortly before. In 1763, he was chosen afternoon preacher to the congregation in Jewry-street, London, when he was also elected a fellow of the Royal society of London. In 1769, the university of Aberdeen presented him with the diploma of doctor of divinity; and in the following year he was chosen pastor of the congregation at the Gravel-pit meeting at Hackney, where he distinguished himself as an able and impressive preacher. This eminent writer and divine died on the 19th March 1791, in the 68th year of his age. Besides his writings on morals, Dr Price was so much esteemed as a political writer, that when Mr Pitt intended to introduce a bill into Parliament for liquidating the national debt, hè consulted Dr Price on the subject, and received from him three different plans, one of which, said to be the least efficient in its operation, was adopted by the minister, though without any acknowledgment of his obligations, and now forms the foundation of that act for reducing the public debt which was established in 1786.

PRIDEAUX, Humphrey, an author well known for his celebrated work on the Connection of the History of the Old and New Testament, was born in 1648 at Padstow in Cornwall. Being designed by his parents for the church, at a proper age he was sent to Westminster school, then conducted by the celebrated Dr Busby, where he was chosen king's scholar, and at the end of three years sent on the foundation to Christchurch college in the university of Oxford. Here, by publishing his *Marmora Oxoniensia*, he gained the notice of Lord-chancellor Finch, who procured him several presentations in the church. In 1686 he became doctor of divinity; about which time he opposed with great zeal the arts of the popish emissaries, who were then very active in propagating the tenets of the Romish church. His most celebrated performance, the Connection of the History of the Old and New Testament, was written in the latter part of his life. He died at the age of 77, in the year 1724. He was a man of extensive learning, and endowed rather with soundness of judgment than quickness of parts. His works are remarkable for perspicuity and precision.

PRIEST, one appointed to perform sacrifices and other religious ceremonies. Before the law of Moses, fathers, princes, and kings, acted as priests among their respective charges. From that period, among the Israelites the priesthood was restricted to the tribe of Levi, the first-born of the eldest branch of that tribe being high priest, if not disqualified by some natural defect. After the Jews became subject to the Romans, however, this was not observed; the high-priesthood being then sometimes set up to sale, though it seems never to have been disposed of but to some descendant of Aaron. The heathens had priests in their superstitions; and the church of Rome, which holds the propitiatory sacrifice of the mass, has also a priesthood. In the church of England the word priest is not used in its proper sense, and merely denotes the second order in her hierarchy.

PRIESTLEY, Joseph, a celebrated philosopher and divine, was born on the 24th March 1733, of parents who belonged to a body of dissenters of the Calvinistic persuasion, at Field-head, near Leeds. The subject of this brief notice, however, early adopted Unitarian principles, of which he became an eminent supporter. He has distinguised himself chiefly by his philosophical labours. His History of Electricity, published 1767, and dedicated to the Earl of Morton, president of the Royal society, with some other chemical treatises, gained him so much reputation that proposals were made to him by the Earl of Shelburne to go and reside in his family, which were too advantageous to be refused. During his residence with Lord Shelburne, he published his Examination of the Doctrine of Common Sense, as held by Drs Reid, Beattie, and Oswald, and in 1777 his Disquisitions on Matter and Spirit, in which he openly supported the material system, which subjected him to a greater degree of odium than any of his former opinions. This was afterwards followed by a defence of Unitarianism, or the simple humanity of Christ, and of the doctrine of philosophical necessity. After continuing in the family for several years, he displeased his Lordship by some of his theological speculations, and retired on a pension of L.150 per annum.

In 1780, having removed to Birmingham, he was invited to become pastor of the dissenting congregation of that place; and being fond of political and theological controversy, he not long after published his letters to Bishop Newcome, on the Duration of Christ's Ministry, his History of the Corruptions of Christianity, and his History of Early Opinions concerning Jesus Christ. The popular rage being roused by the celebration of the anniversary of the destruction of the Bastile, Dr Priestley's house, which was then at Birmingham, was, to the lasting disgrace of the inhabitants, attacked with the utmost fury, and burnt to the ground, together with his literary apparatus and all his manuscripts; and finding that his principles were the object of general dislike in this country, he retired to the United States in 1794. Here he prosecuted his studies with his usual ardour, almost to the very day of his death, which was in the 6th of February 1804, when he was in the 71st year of his age.

Dr Priestley published many valuable papers in the Philosophical Transactions, almost every second or third year, from 1768 to 1791, particularly an account of rings, with all the prismatic colours, made by electrical explosions on the surfaces of pieces of metal. Experiments on the lateral force of electrical explosions; on charcoal; on different kinds of air; on phlogiston, and the seeming immersion of water into air; on air and water; on the principle of acidity, the composition and decomposition of water and phlogiston; on the phlogistication of spirit of nitre; on the transmission of the vapour of acids through a hot earthen tube, and farther observations relating to phlogiston: Also, observations on the noxious quality of the effluvia of putrid marshes; and on respiration and the use of blood.

Dr Priestley was possessed of great ardour and vivacity of intellect; and although ever zealous for the propagation of truth, his heart would not have suffered him to injure even his bitterest enemy. Of a mild and placid temper, he was naturally disposed to be cheerful, especially in the private circle of his friends. Uniformly kind and affectionate in domestic life, he was the tenderest husband, and the best of parents. His integrity was unimpeachable, and even malice itself could not fix a stain on his private character. See Dr Thomson's Biographical Account of Dr Priestley, in his *Annals of Philosophy*, Vol. I.; also, *Memoirs of Dr Joseph Priestley*, in 2 vols. 8vo.

PRIMARY PLANETS. See ASTRONOMY.

PRIMARY ROCKS. See GEOLOGY.

PRIME NUMBERS. See NUMBER.

PRIMOGENITURE, the right of the eldest son, or first-born, in a family. This right has been different in the various ages and countries of the world. In the patriarchal ages, the authority of the eldest son was great, and, in the absence of his father, he acted as priest. In Europe, at present, the eldest son in every country has some rights in preference to the other children of the family. This was not, however, always the case. In the early history of the kings of France, the eldest son of the royal family did not always succeed his father upon the throne, nor was he considered as having any claim to the sceptre superior to that of his younger brothers. Among the Romans, the right of primogeniture was not acknowledged; all the children, male and female, had an equal claim upon the patrimonial estate. And by the ancient custom of Gravel-kind, still preserved in some parts of our island, the paternal estate is equally shared amongst all the sons.

PRIMUM MOBILE, supposed by the ancients to be a vast sphere, having for its centre the centre of the earth, and in the Ptolemaic astronomy the ninth, or highest sphere of the heavens, whose centre is that of the universe, and endowed with the power of motion, by which means it turned itself, and all the heavenly bodies along with it, round the earth once in the 24 hours. They supposed that the earth was immoveable, that the planets revolved around it, and that above them, and including them, was a sphere containing the fixed stars,—and still farther, beyond this, was another sphere, to which they gave the name of the *Primum Mobile*, supposing it to communicate motion to all the rest. This system is usually called the Ptolemaic System, from Ptolemy, a celebrated Egyptian astronomer who explained and supported it. This beautiful and plausible system, is, however, a mere chimera, having no existence but in the imagination of its inventors.

PRINCE, this title is applied sometimes to monarchs who are at the head of independent kingdoms, and sometimes, as in the case of the princes of Germany, to rulers who are supreme in their own territory, and yet owe homage to some superior. The sons of kings, too, are usually stiled princes, as in England, where the king's eldest son is stiled Prince of Wales.

*The Prince of Wales* is born Duke of Cornwall, in consequence of which he is entitled to the immediate enjoyment of all the revenues thereunto belonging. This title and principality was first conferred by Edward I. on his eldest son, who was also stiled Duke of Normandy, but, since the Union, his title is *Magnæ Britanniæ Princeps.*

PRINCE OF WALES ISLAND, or PULO PENANG, lies at the entrance of the straits of Malacca, is about seven leagues in length, and three in breadth, produces a great variety of excellent timber for ship-building, and contains mines of tin, which, however, have never been wrought. Thither persons convicted of felonies in any of the British East India settlements are frequently banished. It was purchased from the king of Queddah, for the East India company, by Mr Light, who took possession of it in 1786. To prevent any jealousy which might arise between the Malay king and the East India company, a treaty was entered into in the year 1791, by which it was stipulated that the king of Queddah should annually receive 6000 dollars; and, nine years afterwards, a tract of land of 18 miles in length, and three in breadth, was likewise ceded to the company for an additional annual revenue of 4000 dollars.

*The climate* of Pulo Penang is extremely healthy and mild, owing, perhaps, to the dryness of the soil, the constant gentle breezes, and the uniform sloping of the ground from the foot of the hills to the shore, which prevents the stagnation of water, so prejudicial to the health of men in tropical latitudes. Out of a garrison of the native troops of Hindostan, consisting of 300, there was not a single death in the course of 14 months. Here are produced the most abundant crops of rice; also pepper, coffee, betel-nut, betel-leaf, ginger, cotton, cocoa-nuts, cabbages, sweet potatoes, and a variety of European vegetables in the greatest perfection. The sugar-cane likewise grows with the utmost luxuriance; and among the exotics are pimento, kyapootee, cinnamon, nutmeg, cloves, and many other native plants of the eastern islands. In the decorations of this fine island, nature has furnished an endless variety of flowering shrubs and trees, which continue in perpetual blossom, and which are sheltered and overtopped by others of immense height, that spread around them vast branches of the richest foliage on every side. A beautiful ridge of mountains, covered with evergreens, runs across the island in a longitudinal direction, and, being lavishly adorned with numerous valleys and innumerable rivulets of transparent waters, renders Pulo Penang not only one of the most healthy, but likewise one of the most beautiful islands any where to be seen. All the domestic animals arrive at great perfection, but none of the ferocious kinds which inhabit the opposite shores are to be found here. The native quadrupeds are few in number, comprehending only the deer, the squirrel, and wild hog, the flying-fox, and flying-squirrel. The birds also are but few, of which only one is distinguished for its melody. No where are the necessaries and luxuries of life enjoyed in greater profusion. The sea produces an immense variety of fish of the most delicious flavour, and the markets are supplied with poultry of all sorts, grain, pork, and the finest fruits and vegetables. The timber of the island is not only abundant, but of great size, and is fit for all the purposes of ship-building. The imports of the island are considerable; the population in 1797, both foreigners and natives, was computed at about 7,000, and in 1810 it was 14,000. How eligible seems such an island for the introduction of a British colony?

The principal place for trade in the island is George Town, which is well built, has spacious and airy streets which cross each other at right angles. Among its finest buildings may be enumerated the church, government-house, jail, the fort containing barracks, the arsenal, pier, and military storehouses. From Europe they import fire arms, cutlery, nails, tin ware, sheet-lead, and copper; cables; common glass, cloth, musical instruments, watches, wines, and liquors; and their produce is generally exported by the Company's ships for the China market.

See Sir Geo. Leith's *Account of Prince of Wales Island*, in the Asiatic Annual Register; Hamilton's *East India Gazetteer*; and Milburn's *Oriental Commerce*, Vol. II.

PRINCE WILLIAM'S SOUND, an inlet on the north-west coast of America, E. long. 116° 21′ N. lat. 59° 35′. It received its name from Captain Cook in 1778, who has given some account of the natives. The dress of both men and women was the same, being a long close frock reaching to the ancles. They also painted their faces a black, and sometimes a red or blue colour. Their implements for fishing and hunting resemble those of the Greenlanders. The country seemed nearly destitute of vegetables, the inhabitants living principally on fish and the flesh of such animals as they killed in the chase.

PRINCIPAL, in law, is the person who, of his own accord, and in his own person, perpetrates a crime, or who procures the commission of it by unconscious agents, as if he should bring it about that another should unknowingly administer poison to a third; the person also who is present at the commission of a crime, and connives at or assists in the fact, is denominated a principal in the second degree.

PRINCIPLES OF BODIES, in chemistry, simple elementary substances which cannot be decomposed or separated into different component parts.

PRINGLE, SIR JOHN, a celebrated physician and philosopher; president of the Royal society of London, and a younger son of Sir John Pringle of Stitchel in Roxburghshire, Scotland, was born 1707. He received his classical education under a private tutor, and having resolved to follow the medical profession, he studied first at St Andrew's, afterwards at Edinburgh, and, lastly, under the great Boerhaave at Leyden, where he took the degree of M.D. in 1730, after writing an inaugural dissertation, *De Marcore Senili*. After this period he resided for some time in Edinburgh, where he was raised to the professorship of moral philosophy in that university, the duties of which office he discharged till 1742, when he was appointed physician to the Earl of Stair, at that time commander-in-chief of the British army. During the campaign of 1744 he was nominated physician-general to his Majesty's forces in Flanders, and also physician to the royal hospitals. In the course of the next ten years he was successively appointed one of the physicians to the hospital of lame, maimed, and sick soldiers behind Buckingham-house, physician in ordinary to the king, and joint physician with Sir Clifton Wintringham Bart. to the hospital for the service of the forces of Great Britain. In 1761 he was chosen physician to the queen's household, and two years afterwards physician extraordinary to the queen, when he was also admitted a member of the Royal college of physicians in London, and on the 5th June 1766 he was advanced to the dignity of a Baronet of Great Britain. He was appointed physician extraordinary to the King, a fellow of the Royal college of physicians in Edinburgh, and of the Medical society at Paris,—of the Royal academies at Paris, Stockholm, Gottingen,—and of the Philosophical society at Edinburgh and Haerlem, and president of the Royal society in London. In 1782 he died at London; and having no children, he was succeeded in his title and estate by his nephew Sir James Pringle, Bart.

Sir John published many valuable essays and papers, chiefly in the Philosophical Transactions, among which are the following: *Some Experiments on Substances resisting Putrefaction*, which appeared in the Transactions, Vol. XLVI. in the year 1750, reprinted with additions in *Martin's Abridgment*, Vol. XI. in 1752; *Account of some Persons seized with the Gaol Fever by working in Newgate; A remarkable case of Fragility, Flexibility, and Dissolution of the Bones; Account of the Earthquake at Brussels, and of the Sinking of a River near Pontypool in Monmouthshire; of an Earthquake felt 18th Feb.* 1756, along the coast of England between Margate and Dover; *of an Earthquake at Glasgow and Dumbarton*; also, *of a Shower of Dust falling on a Ship between Shetland and Iceland; Several Accounts of the Fiery Meteor which appeared Sunday 26th November* 1758, *between eight and nine at night*, which was followed with *Remarks on the several Accounts of the Fiery Meteor and other such bodies; Account of the Virtues of Soap in dissolving the Stone; of the Effects of Electricity in Paralytic Cases:* Besides much valuable information communicated to the Royal Society, in six discourses, delivered by him at the annual assignment of Sir Godfrey Copley's medal. An excellent account of these discourses the reader will find in Dr C. Hutton's *Memoir of his Life in the Mathematical Dictionary*, Vol. II. p. 279, in which will also be found his remarks on *the Different Kinds of Air*; *on the Mountain of Schehallion, or finding its attraction*; his Directions *for making the best Composition for the Metals of Reflecting Telescopes, with the process for grinding, polishing, and giving the great speculum the true parabolic form*; his Remarks on *The Force of Fire, Gunpowder, and the Initial Velocity of Cannon-balls.* During his visit to Edinburgh in 1781, Sir John presented to the Royal college of Physicians ten folio volumes of Medical and Physical Observations, in manuscript. See Dr Keppis's Life of Sir John Pringle, prefixed to his Discourses.

# PRINTING.

Definition.

PRINTING is the art of taking impressions on paper, from characters or figures called types. The art of printing has in some measure been common to all ages from time immemorial. By the ancients it was done upon wax, plaster, and iron, as appears from their seals, rings, and money; and by the Indians it has been done with wooden blocks upon cotton and silk. There are four distinct branches of this art, namely, letter-press printing, stereotype printing, rolling-press printing, calico printing, which latter has been already amply discussed under DYEING.

### SECT. I. *Of Letter-press Printing.*

THIS branch is peculiarly interesting, as to it are owing chiefly our deliverance from ignorance and error, the progress of learning, and the preservation of innumerable improvements in arts. The remark has not unfrequently been made, that as the Grecian cities disputed for the birth of Homer, so three cities in Europe claim the honour of the invention of printing. It is severally ascribed to Laurentius of Haerlem, John Fust or Faust of Mentz, and John Guttemberg of Strasburg; and as they no doubt made improvements upon one another, it may perhaps be in a qualified sense ascribed to each of them. But the honour of completing the discovery is due to Peter Schœffer, who was Fust's son-in-law.

Hadrian Junius, in his Batavia, printed at Leyden, (Lugd. Bat.) in 1588, ascribes the invention to Laurentius, the son of John Koster, or Custos, or Edituus (*i. e.* keeper) of the cathedral at Haerlem, then a respectable office. He states that, "walking in a wood near the city of Laurentius, he began first to cut some letters upon the rind of a beach tree, which, for fancy's sake, being impressed on paper, he printed one or two lines as a specimen for his grandchildren to follow. This having happily succeeded, he meditated greater things, as he was a man of ingenuity and judgment; and, first of all, with his son-in-law, Thomas Peter, (who, by the way, left three sons, who all attained the consular dignity,) invented a more glutinous writing ink, because he found the common ink sunk and spread, and then formed whole pages of wood with letters cut upon them." The first essays in this important art were made on wood, after the Chinese manner; and it would appear that the impression was only given on one side of the leaves, after which the two blank sides were pasted together. This method was soon found to be inconvenient, and single letters, distinct from one another, and done on wood, were therefore introduced. These, however, were at length exchanged for metal types; and as Schœffer is generally allowed to be the inventor of moulds, matrices, &c. for casting them, he may be justly considered the first printer. See FUST, JOHN, under which head we have already noticed the earliest productions of genuine typography.

Letter-press.

Though Fust and Schœffer concerted measures to conceal their improvement, and bound their workmen by an oath of secrecy, the art of printing was not long confined to the city of Mentz, but spread quickly into many parts of Europe. In 1462, Mentz was taken by Archbishop Adolphus of Nassau, and on that occasion Fust and Schœffer experienced, with their fellow townsmen, their share of suffering; but, by the dispersion of their workmen, who now directed their course to different quarters, with the view of making their fortune, the general benefit of printing was promoted, which soon attained a considerable degree of perfection. As its introduction into Paris proved extremely injurious to the interest of the copiers, they presented a complaint to the Parliament, which tribunal was superstitious enough to cause the printer's books be seized and confiscated; but, by the interference of Louis XI., who, whatever he might be in other respects, shewed himself the friend and patron of learning, the property was restored. The art of printing passed into Rome in 1467, and shortly after into England, by means of Thomas Bourchier, archbishop of Canterbury, who sent Robert Turnour, master of the robes, and William Caxton, merchant, to Haerlem, to acquire a knowledge of it. Turnour prevailed with an under workman, of the name of Corseilles, to accompany him to England, and a press was immediately set up at Oxford, which was successively removed to St Alban's, and to Westminster Abbey. Printing was thus established in England before there was any printer or printing press in France, Spain, Italy, or Germany.

It may be proper here to notice when the different characters were first used in printing. Previous to the year 1465, the character commonly adopted was the Gothic, or German, whence our black letter was afterwards formed. An edition of Lactantius' *Institutes* was in that year printed in a kind of semi-gothic, approaching considerably to the present Roman type; which last was first introduced at Rome about the year 1466, in Cicero's *Epistolae Familiares*, and, not long after brought to a great degree of perfection in Italy, especially by Jenson. The Italic character, called Aldine, or Cursivus, from Aldus, the name of the inventor, came into use about the close of the fifteenth century.

*Principles of the art.*—In the business of printing, the men employed are compositors and pressmen. By the former, the letters are ranged and disposed into words, lines, pages, &c.; and by the latter, impressions are taken off the letters when they have been thoroughly prepared for the purpose by the compositors. The types are properly distributed, each particular kind or sort by itself, in two wooden frames, an upper and a lower, denominated cases. Both of these cases are divided into small cells or boxes, of which there are 98 in the upper, and 54 in the lower. Two alphabets of capitals, large or full capitals, and small capitals, are disposed, alphabetically in the upper case, which likewise has cells for the figures, accented letters, characters of reference, &c. as well as a middle cell in the bottom row for the letter k. In the cells of the lower case are placed the small letters, with the points, spaces, parenthesis, and quadrats. There are different sizes of boxes in the lower case, the largest of which is devoted to the letters most in use; but, in this instance, the arrangement is not alphabetical, those letters most required being usually laid nearest to the hand of the compositor. The two cases are placed in an inclined direction, that the upper one may, with facility, be reached by the compositor. It is not a little curious to observe the dexterity with which the workmen take from the different cells the particular letters they want, more especially as no marks appear on the boxes to indicate their respective letters. An instrument called a composing-stick is employed for setting the letters. It consists of a long and narrow plate of brass or iron, on the right side of which arises a ledge that runs the whole length of the plate, and serves to sustain the letters, whose sides are placed against it. There is a row of holes along this ledge, for the purpose of introducing a screw to lengthen or shorten the line, by moving the sliders nearer to or farther from the short ledge at the end of the composing-stick. In case marginal notes are required, the two sliding pieces are opened to such a distance from each other, as to answer the purpose. Previous to his commencing work, the compositor puts a thin slip of brass plate, commonly called a rule, cut to the length of the line, and of the same height as the letter, in the composing-stick, parallel with the ledge against which the letters are designed to bear. Being thus provided with an instrument for holding the letters as they are disposed into words and lines, he lays his copy upon the upper case directly before him, and holding the stick in his left hand, his thumb being over the slider, he, with the right, takes up the letters, spaces, &c. one by one, and lays them against the rule, while, with his left thumb, he supports them, by pressing them against the slider, the other hand being constantly occupied in setting in other letters. When a line has been thus composed, the brass rule is taken from behind it, and placed before the letters of which it is composed, and another line is immediately proceeded with in the same manner. Before removing the brass rule, however, the compositor observes if the line terminate with a complete word, or with an entire syllable of a word, including the hyphen; and if he find that his words fill the measure exactly, he has nothing more to do with that line, and therefore proceeds with the next. The operation of *justifying*, as it is called, consists in putting in more spaces, or diminishing the distance between the words, when the measure appears not entirely filled at the ending of a word or syllable. In this process great exactness is requisite, and care must be taken that the lines be not too closely wedged into the composing stick, and that they be not loose or uneven. The pieces of metal called spaces, are shapen like the shanks of the letters, and being employed to regulate the distances between the words, they are of various thicknesses. A complete page being formed in the manner described, the compositor ties it up with a piece of pack-thread, and removes it from the galley, which is a thin board of an oblong form, with a ledge on the side, and a groove to admit a false bottom. In this manner he proceeds till he has composed as many pages as are contained in a sheet or half-sheet, when he proceeds to arrange the pages on a large oblong stone of about five or six inches in thickness, called an imposing-stone. The operation termed *imposing* consists in fastening the pages, duly arranged, in a rectangular iron frame, denominated a chase. According to the size of the paper to be printed, the chase differs in size, and it has two cross pieces named a long and a short cross, mortised at each end, that it may be occasionally taken out. It is by the different situations of these crosses that the chase is fitted for folios, quartos, octavos, &c. No small ingenuity and attention are necessary in this department of the art, especially in works less in size than quarto; and, therefore, above fifty schemes for imposing sheets of all sizes are given by Stower in his valuable treatise the Printer's Grammar.

The pages being laid in proper order on the imposing-stone, the next business to be attended to is *dressing the chase*, that is, ranging and fixing the pages in the chase. For accomplishing this purpose, a set of furniture is employed consisting of slips of wood of different dimensions. Of these slips of wood, some are put at the top of the pages, and called head-sticks, others being placed between them form the inner margin, some are placed on the outside of the crosses for the formation of the outer margin where the paper must be doubled, and others are applied to the sides and bottoms of the pages. That part of the furniture placed between the respective pages is called gutter-sticks, and that placed along the sides of the crosses of the chase is called reglets. The latter are of such thickness as will admit of the book having proper margins after it is bound. The pages being accurately placed, they are next untied, and connected together by means of small wooden wedges called quoins, which are driven firmly up the sides of the pages with the assistance of a mallet and shooting-stick, which is a piece of hard wood. All the letters are thus bound together in such a way, that, if care be taken, none of them will fall out. In this state the work is denominated a *form*, and is ready for the pressman, whose business it is to pull a proof of it. As there are two forms for each sheet, when both sides are to be printed, care must be taken that the distances between the pages in each form be so exactly placed that the impression of the pages in one form may fall on the back of the pages of the other, which is called *register*.

Mistakes being almost unavoidable, even with the most cautious compositor, the proof-sheet, together with the copy from which it has been composed, is handed to the corrector, who reads it over and marks the errata in the margin,—when he returns it to the compositor, that the necessary corrections may be made. In reading proofs, particular characters are used to denote the different corrections, which are always placed against the line in which the faults are found. When any omission occurs, the place of insertion is marked with a caret, ʌ, while in the margin is written the thing required to be inserted. To signify that a word, letter, or point is to be taken out, it is dashed in the line and a mark for *dele* not unlike the Greek theta ϑ is placed against it. If two letters or words require to be separated, a mark thus # is put in the margin, and a parallel line is made where the separation ought to be. When a word happens to be divided which ought to be in one, it is marked thus *mer‿it*, and the character ‿ is likewise placed in the margin. A mark nearly resembling the dele character inverted, signifies that a letter is turned. Sometimes a part of a sentence requires to be transposed, in which case *tr.* is marked against the line where the transposition is to be made, while the words to be transposed are denoted thus:

| Blind | is | Fortune.

for *Fortune is blind.* A space rising up between two words is noticed by a line being made in the margin thus | If italic letters must be changed for Roman, or *vice versa*, a line is drawn under the letters, and *ital.* or *rom.* is written in the margin. Two lines drawn under a word denote that the word be in capitals. When a new paragraph is required, *N. L.* is marked at the place, or a line in the shape of a crotchet [; and where a paragraph ought not to have been made, a line is drawn from the broken-off matter to the next paragraph, while in the margin the words *no break* are written. It is usual, when several corrections occur successively in the same line, to place a mark between each of them thus | In altering the punctuation, the comma, semicolon, and colon, are marked in the same way as letters or words are, but the period is commonly encircled. The word *stet.* is frequently adopted to signify that certain words, which have been by mistake struck out, must be retained. Some other marks are employed in correcting for the press, as *w. f.* for wrong fount, *cap.* for capitals, *l. c.* for lower case, &c.—but those noticed above are the most important.

In order to rectify the mistakes that have unavoidably occurred in setting up the sheet, the compositor has to unlock the form upon the imposing-stone. With the aid of a slender sharp-pointed steel bodkin, he then picks out the improper types, and, as directed, substitutes others in their place. After the first proof has been corrected, a second one is pulled for the purpose of being examined by the corrector; and, lastly, a *revise* is pulled to discover if all the errata marked in the second proof have been attended to.

*Press Work.*—The sheet being at length pronounced ready for press, the forms are given to the pressman, whose business it is to work them off. For this purpose, four things are necessary, paper, ink, an instrument for applying the ink, and a printing press.

To prepare the paper for use, it is dipped, a few sheets at a time, in water, and then laid in a heap that the water may penetrate equally into every sheet; for which purpose, a thick deal board is laid upon the heap, and above it a number of heavy weights according to the quantity of the paper. By this process the paper is rendered sufficiently soft to adhere closely to the surface of the lettter, and take up a proper portion of ink for a fair and clear impression. Were the paper not wetted in this manner, its stiff nature, when dry, might prove injurious to the face of the letters.

Printer's ink is made of oil and lamp-black; the manner in which it is prepared has been described under the article INK, which see. To such perfection has the manufacture of ink been brought, especially that used in fine printing, that impressions can now be produced remarkably free from that offensive brown cast observable in many books printed with what is denominated common ink.

For applying the ink on the forms, a kind of wooden funnels with handles, were formerly in use, the cavities of which were filled with wool or hair, as was also a piece of leather or pelt nailed over the cavity, and rendered soft by soaking in urine, and by being well rubbed. The pressman taking one of them in each hand, and applying one of them to the ink-block, daubed and worked them together, to distribute the ink equally; he then blackened the form, which was placed on the press, by beating with the balls upon the face of the letter. A superior method of applying the ink has been recently invented, that is, by means of rollers, which consist of a cylinder, composed of a soft glutinous substance, that runs on an iron rod, to which two handles are affixed. This cylinder is rolled over the face of the form, and thus the ink is applied in an even manner, and with very little labour.

The form, parts, and general structure of the printing-press, are very curious, and there is now a great variety in the construction of machines of this kind. The *Common Printing-Press* consists of two upright beams, called cheeks, which are commonly about six feet one inch in length, eight inches and a half in breadth, and five inches thick, with a tennon at each end. The tennon at the upper end of the cheek is cut across the breadth, and enters the cap within half an inch of the top. That piece of solid timber called the cap is three feet long, eleven inches wide, and four inches thick. The lower tennon of the cheek enters the strong wooden frame called the feet. By means of two iron bolts that pass through the cap, the head, which is moveable, is properly sustained. The spindle, which is an upright piece of iron, pointed with steel, having a male screw that goes about four inches into the female one in the head, is so contrived, that when the pressman pulls a lever attached to it, the pointed end of it works in a steel pan or cap, supplied with oil, which is joined to an iron plate, let into the top of a broad thick piece of mahogany called the platen. The platen being made to rise and fall, as the lever or bar is pulled or let go, it presses upon a blanket, whereby the paper is covered when it lies upon the form from which the impression is to be taken. A broad flat stone, or thick marble slab, supports the form. This stone is let into a wooden frame, named the coffin, and which, by the turning of a winch, moves backwards and forwards. There are three frames at the end of the coffin, two of which are called tympans, and the third one a frisket. These tympans are made of three slips of very thin wood, with a piece of iron, still thinner, at the top. Both of them are covered with parchment, and between the two are placed blankets, which are of essential

# PRESSES

PLATE 155.

OLIVE PRESS

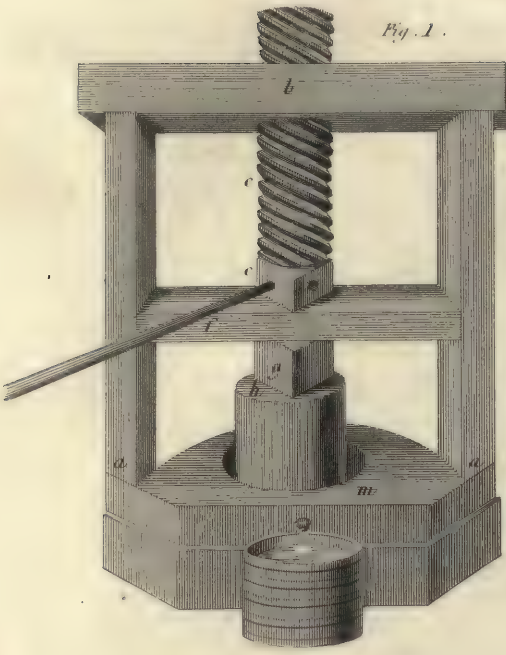


Fig. 1.

PEAK'S DOUBLE PRESS

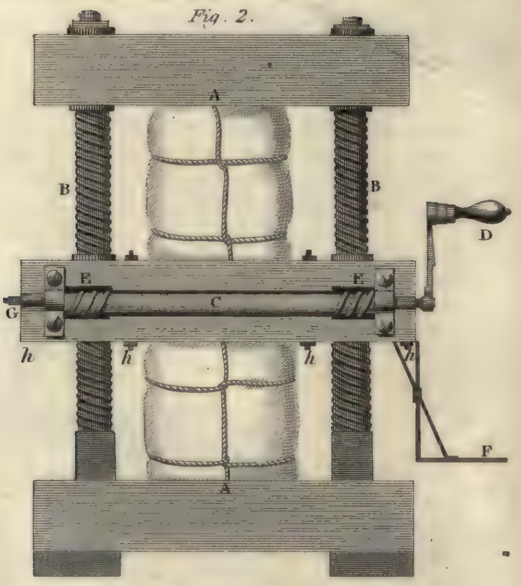


Fig. 2.

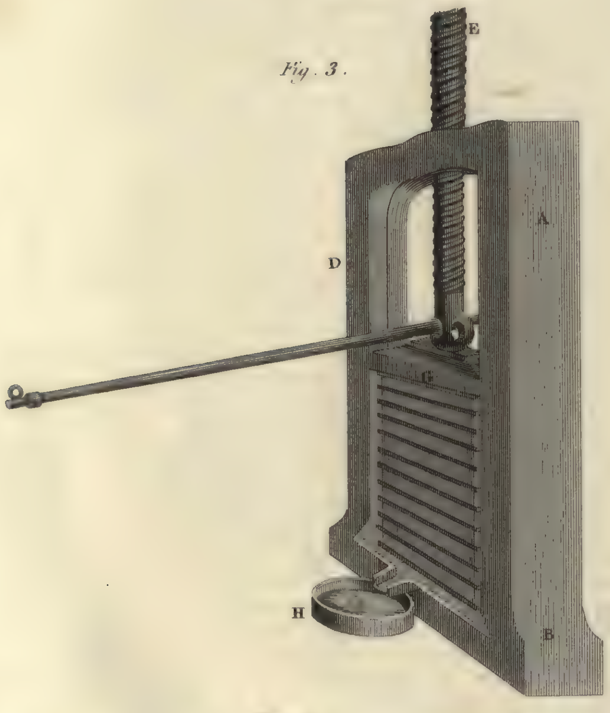


Fig. 3.

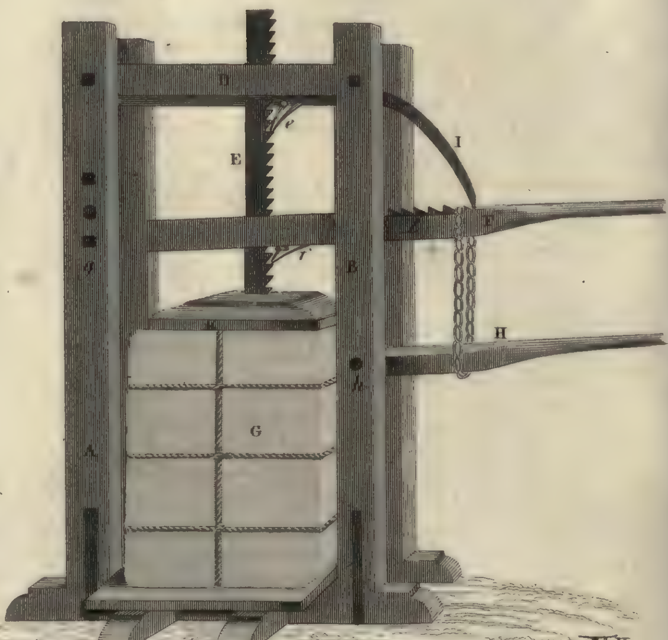


Fig. 4.

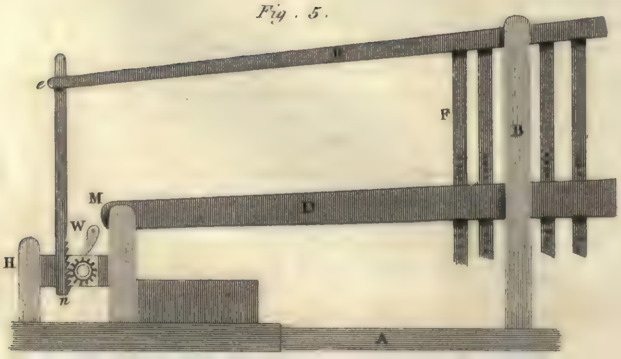


Fig. 5.

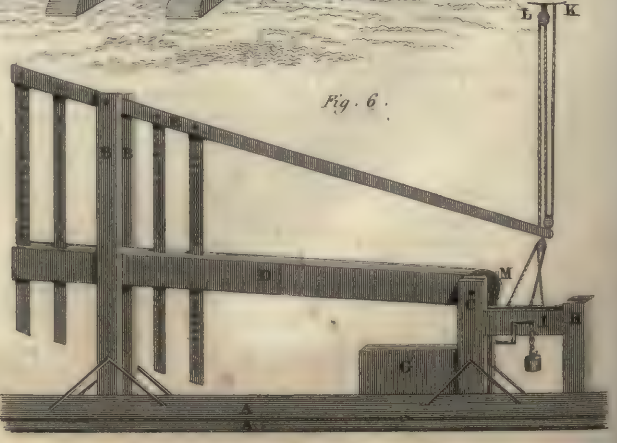


Fig. 6.

use to take off the impression upon the paper. That called the outer tympan is attached to the coffin by means of hinges. The frisket is a square frame of thin iron, fastened to the tympan with hinges. It is covered with paper, cut in such a manner that the sheet, which is put between the frisket and the outer tympan may receive the ink, and that the margins may not be injured in any way. For the purpose of regulating the margins, a sheet of paper is attached to the outer tympan; and this, which is called the tympan-sheet, is to be changed when it has become wet with the paper used in printing. An iron point is fixed on each side, which makes two holes in the sheet, and the sheet must be put on the same points when the impression is to be made on the other side.

Considerable attention is necessary in preparing the press for working, or, as the pressmen express it, *making ready a form*, that the lines on one side of the printed sheets may fall exactly on the back of the other, which is called register. To render the impression as equable as possible, the parchment covering the outer tympan is duly wetted to soften it, and the blankets, being then put in, are secured from slipping by the outer tympan. All things being in perfect readiness for working, one man applies the ink by means of the roller already described, another puts a sheet of paper on the tympan-sheet, turns the frisket upon it to secure the paper, then bringing down the tympan upon the form, and turning the wince or rounce, by which the carriage, holding the coffin, stone, and form is moved, he brings the form, &c. under the broad thick piece of mahogany called a platen, and pulls with the bar, so that the blankets and paper are pressed upon the letters. Half the form being thus printed, the pressman, easing the bar, draws the form still forward, pulls a second time, and letting go the bar, turns back the carriage, raises the tympans and frisket, takes out the printed sheet, and lays on a fresh one. This process is repeated till the whole impression of which the edition is to consist has been taken off. As one side of every sheet is printed, the form for the other side is laid on the press, and worked off in the same manner. The press now described is constructed on the genuine principles of mechanism, but it requires considerable labour and care in working. To gain an accession of power, therefore, together with a diminution of labour, was a great desideratum in the printing business. The iron press, invented by Earl Stanhope, is capable of ten times the force of the common press, with probably a tenth part of the labour. Almost nothing is left to the judgment of the pressman in working this excellent press, of the nature and construction of which a minute account is to be found in Stower's Printer's Grammar, a very judicious and copious work on the subject of printing.

In the construction of the *common press*, the Stanhopian principle has been applied, but not with that success which was at first expected; but the presses so formed, and first made by Mr Baker, are said to produce a better impression, especially from light forms, than the common press. The sharpness and smoothness of impression, however, produced by the Stanhopian press, from forms of pearl and nonpareil letter, cannot be looked for from the common press constructed on the same principle.

*The Stanhope Press*,—a perspective representation of which is given in Plate 156, is composed of a solid cast iron frame in one piece, firmly screwed upon a wooden cross. This press is moved by a handle nearly in the same manner as the common press. The improvement on this press was made by the late ingenious Earl of Stanhope, and consists chiefly in the method of giving to the screw its descending motion, so that the greatest pressure is produced at the instant the platen touches the paper that is to be printed, this being exactly the moment when the greatest force is required. To vary the pressure as may best suit the different kinds of work, the range of the handle is limited by a moveable stop, and the form of types rests upon a cast iron block in place of stone, the upper surface of which is perfectly smooth and horizontal; and so large is the platen, that a full sheet can be printed at one pull. Several improvements have been made upon this printing-press, and one in particular by M. de Heine, who in place of the screw has substituted an inclined plane of a curved or spiral form, which is fastened to the upper part of the press. The operations of the screw are superseded by means of a cross arm fixed upon the upper part of the spindle, which acts against the curved inclined plane, and in consequence of this the acting faces can be made of hardened steel. This improvement has been secured to the inventor by a patent. Another improvement has been made upon the Stanhope press by Mr Keir, who has considerably altered the lever apparatus, by which the spindle is made to rise and fall so as to equal the descent of the great screw through a given space at the same time, and the connecting rod by this means is pulled in a horizontal plane. Mr Midhurst has made another improvement upon this printing-press, which consists in making the platen the size of a sheet, and in lieu of a screw substituting a plain spindle with a circular plate fixed on the lower extremity of it just above the bar, and which answers as steps for the points of two iron rods, which assume an inclined position when the platen is raised, although the distance of both ends of them from the centre of the spindle is equal; but as the spindle is turned, the plate in which the extremities of the iron rods are made to rest, moves about in a circle while the upper extremities are stationary. In consequence of this motion, when they come towards a vertical position, the spindle and platen descend. By this means the friction is greatly diminished, and when the rods come nearly parallel to the spindle this power is vastly great. Within the last few years, iron presses have been invented, some of which are much approved, and are gradually superseding the use of the Stanhope.

*Columbian Press*.—The great desiderata in the construction of a printing-press are, mechanical precision of impression, and such superabundant power as to render the working of it easy to the workman. This press, the invention of Mr George Clymer of Philadelphia, and which was introduced into London in the year 1818, possesses these requisites in an eminent degree. The power is obtained by a complication of levers, so contrived as to occupy very little space, considering the greatness of the mechanical power. These levers will be seen at B, E, and Q, which are acted on by the bar-handle H, and rod G, by pulling forward the bar-handle. By these levers being acted on, the main one, B, is made to pass upon the piston L, which, in its turn, communicates the perpendicular pressure to the platen O, by which means the impression is made. The tympanum is arranged similarly to that of the common printing press.

A, A, The cheeks.
B, Main lever, the axis of which is seen at C.
D, D, The connecting rod.
E, Lever, the axis of which is marked by F.
G, Rod for graduating the degree of pressure upon the types.
H, The bar-handle, the axis seen at I.
K, Axis of graduating rod.
L, Piston.
M, Top of piston, upon which the lever passes.
N, N, Apparatus for retaining the piston in its perpendicularity.
O, The platen.
P, P, Bolts for fixing and directing piston to the platen.
Q, Upper lever, with its axis at R.
T, Connecting rod.
U, W, Balance lever.
V, Pressure check.
X, X, Ribs.
Y, The carriage.
Z, The handle for rolling in and out the carriage with the form and paper.

*Printing by Steam.*—This operation will be best explained by reference to Plate 156. A represents the sheet of white paper, the first side of which is printed by the cylinder B; and D gives the final impression, after it has travelled over C C, the intermediate cylinders. The inking rollers are at E, under which the form with the types is inked in the act of pressing; F is the reservoir from which the inking rollers are supplied, and G is the form which receives the last inking as it passes under the cylinder. The printed sheet is delivered into the hands of the attendant at H, who lays the sheets in a heap as he receives them. The lines above the machine are the tapes by which the sheet is secured and carried round the cylinders.

*Self-Inking Press.*—A new self-inking press has lately been invented by Mr Hugh Wilson, engraver, Glasgow.

This press differs from other printing presses, first, in the application of the ink to the rollers, second, in its application to the types, and third, in the mode of producing the pressure by which the impression of the types is made on the paper. The regular inking of the rollers is a matter of great importance in the art of printing, and numerous devices have been adopted to accomplish this purpose. To facilitate the operation of inking by composition rollers, Mr T. Parkins of London has lately produced an apparatus, which in its application is supposed to be suited for printing-presses of almost every description. Experience, however, has not yet sufficiently established the superiority of this invention over the common elastic rollers; and therefore Mr Wilson has proposed the following method for inking the rollers and the types more uniformly, while at same time it saves the labour of a man, and does the work more accurately.

In Mr Wilson's press, the application of the ink to the types is effected by two composition rollers fixed to the tympan frame by two horizontal bars, which, at their extremities, are connected by another cross bar that passes through a wheel revolving on a centre bar which is fixed in the type carriage. As soon as the tympan frame is raised up, the roller frame is moved back by two connecting bars reaching from the tympan frame to the ends of the cross bar. These two rollers having been previously inked by the distributing and feeding rollers, are, by the motion produced in throwing up the tympan frame, made to pass over the types, which, by this means, are supplied with ink. The two composition rollers are again drawn across the types, when the tympan frame, with the paper, is brought down upon the types to pass under the press. The effect which is thus produced in inking the types is equivalent to what the common roller could accomplish, if drawn over them four times. The type carriage is then moved forward till it be directly under the centre of the pressure produced by an excentric wheel, which is below the type-carriage, working against a friction wheel, and raising a metal block, which forces the type-carriage upwards against the platen, and thus produces the impression. The excentric wheel is moved by a lever, and the motion of the lever is communicated to the wheel by means of an universal joint. This wheel produces the pressure, and moves the feeding-roller by describing one quarter of an entire revolution. By means of a trough, the feeding-roller is supplied with ink. The distributing and feeding-rollers are brought in contact while the impression is produced, by which means a sufficient quantity of ink is obtained for the next impression. In throwing up the tympan-frame to take out the impression, the rollers are again drawn over the types, so that the operation just described is repeated.

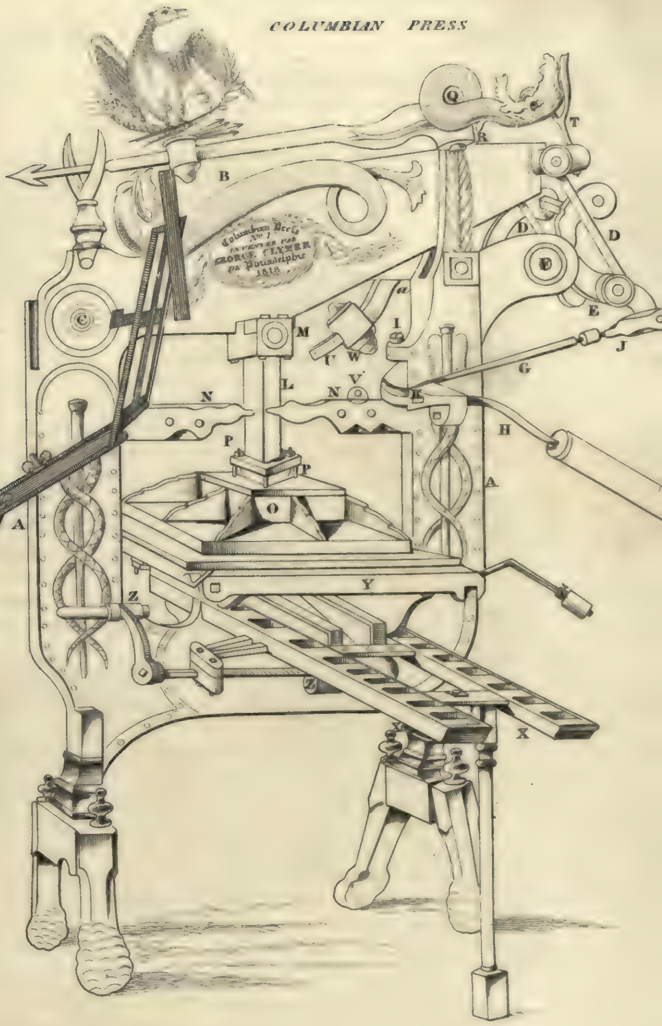
This press possesses another very great advantage. Such is the construction of the tympan-frame, that the paper, intended for the impression, is caused to revolve upon its centre, so that when it has received an impression on the one side, the pressmen can instantly turn it and throw it down upon the types, and take an impression upon the contrary side, in much less time than this could have been done in the common press. This and other ingenious contrivances displayed in Mr Wilson's press, are highly deserving the attention of those who may have occasion to be employed in this branch of machinery. A plate of this self-inking press, and a more detailed description of it, will be found in the Glasgow Mechanics Magazine, Vol. I.

## Sect. III. *Of Stereotype Printing.*

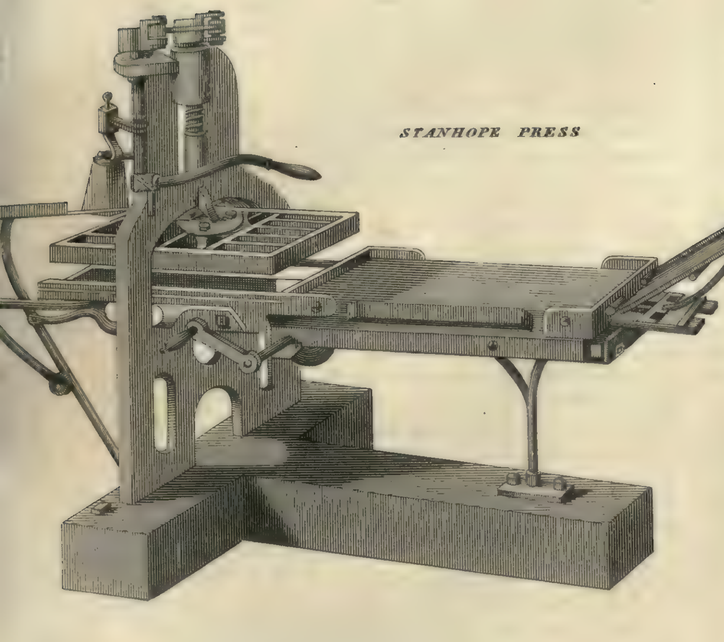
As the first ideas of stereotype printing were anterior to those of printing by moveable types, it would perhaps not have been improper to treat of this art

# PRESSES

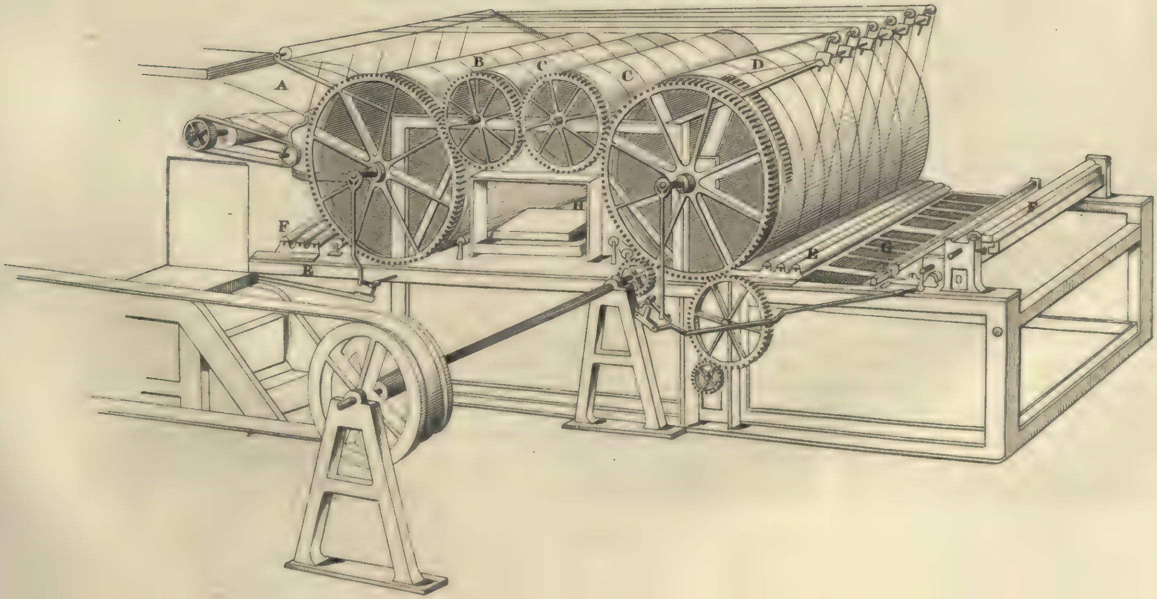
COLUMBIAN PRESS



STANHOPE PRESS



PRINTING BY STEAM



before that of common printing. It appears, that from time immemorial the method of printing paper and linen for hangings has been practised in the east. In China, the art of printing from wooden blocks has been known more than sixteen hundred years. By this method, when an author is desirous to have his work printed, he has it fairly copied upon a thin and transparent paper, after which each leaf is reversed, and fastened on a smooth block of hard wood, whereon the engraver cuts the characters in relief. A separate block is consequently necessary for every page.

About the close of the last century, a method of printing, in which the types employed, instead of answering only to single letters, were made to correspond to whole words, was practised for a short time; but this method, which received the name of *logography*, has been entirely exploded since the introduction of stereotype printing.

According to the accounts of Mr Tilloch, the art of printing with solid or fixed types was known in the seventeenth century. It is not recorded, however, to whom properly belongs the honour of the invention of modern stereotype. Mr Ged began to prosecute plate-printing about the year 1725, as appears from a very interesting pamphlet, entitled Biographical Memoirs of William Ged, printed in London in 1781. (See GED.) About fifty years after the invention of plate-printing, Mr Tilloch, without having at the time any knowledge of Mr Ged's discovery, made a similar one of his own; and with the assistance and joint labour of Mr Foulis, printer to the university of Glasgow, he greatly improved the invention, after many experiments and much labour. " Though we had reason to fear," says Mr Tilloch, " from what we afterwards found Ged had met with, that our efforts would experience a similar opposition from prejudice and ignorance, we persevered in our object for a considerable time, and at last resolved to take out patents for England and Scotland, to secure to ourselves, for the usual term, the benefits of our invention; for the discovery was still as much our own as if nothing similar had been practised before. Ged's knowledge of the art having died with his son, whose proposals for reviving it in 1751 not having been followed with success, he went to Jamaica, where he died. The patents were accordingly obtained; nay, they were even expired; and yet we hear people, who only began their stereotype labours yesterday, taking to themselves the merit of being the first inventors." Owing to circumstances of a private nature, the business was for a time laid aside, and the concern was at length dropped entirely, after Mr Tilloch's removal from Glasgow to London. Prior to this, however, a number of small volumes had been stereotyped and printed under the direction of Messrs Tilloch and Foulis.

Didot, the celebrated French printer, sometime afterwards applied the stereotype art to logarithmic tables, and then to some of the Latin classics, as well as to a number of French publications. Mr Wilson, a respectable printer in London, engaged with Earl Stanhope, some years after Mr Tilloch had relinquished the prosecution of the art, for the purpose of bringing it to perfection, and having it eventually established in this country. It is said that his Lordship was instructed by Mr Tilloch, and afterwards had, at his estate of Chevening, the personal attendance of Mr Foulis for several months. Two years elapsed after this, when Mr Wilson announced to the public, " that the genius and perseverance of Earl Stanhope (whom he styles *the Right Honourable Inventor)* had overcome every difficulty; and that accordingly the various processes of the stereotype art had been admirably contrived, combining the most beautiful simplicity with the most desirable economy, the *ne plus ultra* of perfection with that of cheapness, as to yield the best encouragement to the public for looking forward to the happy period when an application of this valuable art to the manufacture of books, would be the means of reducing the prices of all standard works, at least thirty, and in many cases fifty per cent." With the approbation of Lord Stanhope, this art was, in January 1804, offered by Mr Wilson to the university of Cambridge, for their adoption and use in the printing of bibles, testaments, and prayer books. Bnt some difference having arisen between Mr Wilson and the syndics of the university, the contract was in consequence dissolved. On this occasion Mr Wilson published his case in a stereotyped pamphlet, entitled, " Arbitration between the University of Cambridge and Andrew Wilson." The terms on which Mr Wilson made this offer to the university were highly advantageous to himself; for, with his Lordship's characteristic generosity, Earl Stanhope uniformly declined to accept even the reimbursement of any part of the monies by him expended in the prosecution of this ingenious art.

It must be perceived, from this rapid history of the invention, that the precise mode of procedure in this art has been hitherto a secret, known only to a few individuals. The general mode of stereotype printing is first to set up a page, for example, in the common way, with moveable types. This being rendered as accurate as the nature of the thing will admit, a cast is then taken from it; in which cast the metal for the stereotype plate is poured. The same procedure is followed for every page or sheet designed to be stereotyped. The prepared plates are printed off at the Stanhopian press. Any works hitherto published that have been printed in this manner are confessedly very beautiful, and as correct, likewise, as the best editions of works printed in the usual way.

Besides the saving attributed to stereotype printing, it is insisted by the friends of the art that it possesses a security against error, and that as every page of the book has a separate plate, all its pages must be equally new and beautiful, which can hardly be the case with single types, which are distributed and re-composed several times over in the course of an extensive work. Stereotype plates are said to admit of alteration, but this, if carried to any extent, must be attended with great expense. As to the accuracy of stereotype printing, it is evident that first editions of works cannot possibly be more correct when stereotyped than when printed in the common way. It must, upon the whole, be admitted, that the stereotype art has much the advantage of common printing in standard works, which are constantly in request with the public; but the common method of printing is by far the best for the more general purposes of the art. As it does not appear that any actual saving can be obtained in the manufacture of books in general, this curious invention has not been deemed worthy of patronage and encouragement on the part of the London publishers.

### Sect. IV. *Of Rolling-press Printing.*

This art, which is employed in taking off impressions from copperplates, is said to have been discovered in 1460 by Finiguerra, a Florentine goldsmith. Under the article Design, we have already given an account of the origin of engraving, and of its progress in the German, Italian, French, and English schools. See Design. Rolling-press printing differs from letter-printing in that the marks and characters, whose impressions are to be taken in the former case, are indented or cut inwards, while in the latter they are in relievo, or stand out. The press used in this department consists of the body and carriage. The former consists of two wooden cheeks, placed perpendicularly on a stand or foot, which sustains the whole machine. There are, likewise, four perpendicular pieces from the foot, sustaining a smooth even plank, or table, about four feet and a half in length, two feet and a half in breadth, and an inch and a half in thickness. Two wooden cylinders, or rollers, go into the cheeks; they are about six inches in diameter, borne up at each end by the cheeks, whose ends, which are lessened to about two inches diameter, and denominated trunnions, turn about in the cheeks two pieces of wood, of a crescent form, lined with polished iron, to facilitate the motion. Lastly, a cross is fixed to one of the upper rollers, which cross consists of two pieces of wood traversing each other: The arms of this cross serve the same purpose of the bar or handle of the letter-press, by turning the roller; and when the plank is between the two rollers, giving to the under one the same motion, by drawing the plank forward and backward.

The composition of the ink employed in rolling-press printing, and the manner of taking off prints, is as follows. The ink consists of the stones of apricots and peaches, with ivory, and the bones of sheep, all well burnt, mixed with nut-oil, which has been well boiled, and properly ground together on a marble, as colours are ground. In printing from copper-plates, the workmen take a small portion of this ink on a rubber made of linen rags, strongly bound about each other, and with this smear the whole face of the plate as it lies on a grate over a fire of charcoal. After the plate has been inked sufficiently, it is first wiped over with a foul rag, then with the palm of the left hand, and lastly with that of the right. It is likewise rubbed from time to time in whiting, in order to dry the hands and forward the wiping. The address of the workman consists in wiping the plate perfectly clean, without the ink being taken out of the engraving. Thus prepared, the plate is placed on the plank of the press; the paper, first well moistened to receive the impression, is laid over the plate, and several folds of flannel over the paper. When matters are duly disposed, the plate with its furniture is passed through between the rollers by means of pulling the arms of the cross. In this manner the moistened paper is pressed with proper force into the strokes of the engraving, and thus receives the impression.

*Lithographic printing*, or the art of taking impressions from drawings made on stone, is a recent invention, which promises to be of very great importance to society. For an account of this art, see Design.

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PRIOR, Matthew, an English poet, much admired for the delicacy of his numbers, the wittiness of his turns, and the acuteness of his remarks, was born at London in 1664. His Solomon, a poem on the vanity of the world, is reckoned an excellent piece. Its author, however, was a courtier as well as a poet, for he was introduced to King William and Queen Mary by his patron the earl of Dorset, and both during their reign and that of Anne he continued to be employed in various civil capacities. He was minister plenipotentiary at the negociating of the peace of Utrecht, and continued at the French court in the character of British ambassador till he was succeeded by the earl of Stair, a few months after the accession of George I. At his return home, Prior was put under close custody as an enemy to the Hanoverian succession. He was at last, however, discharged, and ended his days in peace. He died at a seat belonging to the earl of Oxford, near Cambridge, in the year 1721, and was buried in Westminster abbey.

PRIORY, a society of religious, subject to a prior or prioress. Sometimes the prior was independent, being chosen by the members of his convent; such were the cathedral priors, and most of the Austin order. In other convents, the prior was subordinate to the abbot of some great abbey, being appointed and displaced at his pleasure. There were also priories alien in England, which were religious houses depending upon foreign monasteries. These transmitted all their revenues to their foreign head houses; for which reason the English princes, when at war with France, usually seized upon their estates to defray the expences of the war, and restored them again upon a peace being concluded.

PRISCIAN, Priscianus, this celebrated grammarian was born at Cæsarea about the year 525, and taught grammar and rhetoric at Constantinople with great ability and success. He composed a work, *De Arte Grammatica*, and another *De Naturalibus Questionibus*, which he dedicated to Chosroes king of Persia. So great was his celebrity as a grammarian, that to violate a rule of grammar was called breaking Priscian's head.

PRISM, a solid whose two ends are equal, similar, and parallel planes, and its sides parallelograms. See GEOMETRY and OPTICS.

PRISON, a place of confinement, or, according to its original meaning, a place of safe custody. Sometimes it is considered as a place of temporary punishment for certain crimes, and by the judge, in particular cases, may be substituted for transportation, or even death. In Pennsylvania, imprisonment is designed not only as an expiation for past offences, but also for the reformation and improvement of the criminal's morals; and viewing it in this light, the gaol may be considered rather as a penitentiary than a prison. The treatment of each offender varies, according to the nature of his crime, and the evidence of his repentance. On his commitment to prison, his hair is shorn, and he is caused to wash, and is then furnished with apparel, and put into a solitary cell, where he is not permitted to converse with any living creature, or even to see any human being except the gaoler; and if committed for a heinous offence, he is excluded from the light of heaven. For an atrocious crime, the imprisonment is not less than ten years, nor more than twenty-one. He is subsisted on bread and water, is supplied with clean linen regularly, and is made to bathe twice a week. Such as work are allowed broth and puddings, and a small portion of meat twice a week, and prisoners of every trade have a separate room.

In Venice, under the old government, the treatment of prisoners was quite the reverse. The cells were dark and black, destitute of all circulation of air, nine feet square, from six to seven feet high, with each a wall of eight inches diameter, through which the prisoner's allowance of twelve ounces of bread and a pot of water was daily delivered. All the furniture within was a little straw now and then renewed, and a small tub, which, through an iron door, was emptied occasionally. Dr Mosely, who visited this horrible place in 1787, and was conducted through the prison by one of its inferior dependants, gives the following account:

"I saw one man who had been in a cell thirty years, two who had been twelve, and several who had been eight and nine years in their respective cells. By my taper's light I could discover the prisoners' horrid countenances. They were all naked. The man who had been there thirty years, in face and body was covered with long hair. He had lost the arrangement of language. One who still recollected the difference between day and night, implored, in the most piercing manner, that I would prevail on the gaoler to murder him, or to give him some instrument to destroy himself. I told him I had no power to serve him in this request. He then entreated I would use my endeavours with the inquisitors to get him hanged, or drowned in the Canal Orfano. But even in this I could not serve him; death was a favour I had not interest enough to procure for him. This kindness of death, however, was, during my stay in Venice, granted to one man, who had been, 'from the cheerful ways of man cut off' thirteen years. Before he left his dungeon I had some conversation with him; this was six days previous to his execution. His transport at the prospect of death was surprising. He longed for the happy moment. No saint ever exhibited more fervour in anticipating the joys of a future state than this man did at the thoughts of being released from life during the four days mockery of his trial." See EDUCATION.

PRIVATEERS, vessels of war equipped by private individuals, but commanded by an officer appointed by the admiralty, or whatever body have the management of a country's marine. Besides these, there is another species, in which the commanders receive pay from government, and may be punished with death if they disobey orders issued by their superiors. Ships taken by privateers were divided into five parts, four of which went to the owners of the privateer, and the remaining fifth to his majesty. Privateers were not to attempt any thing contrary to the law of nations, as the assaulting an enemy in a port or haven under the protection of any friendly or neuter power. And the commanders of privateers are obliged to give security that they will do nothing contrary to the laws of war. Any ship so offending was liable to be forfeited.

PRIVILEGE in law, some benefit assigned to persons or places contrary to the usual course of the law. Privileges granted to peers, ambassadors, members of parliament, &c. are called personal privileges; those, which belong to particular places, as the king's palace, the courts of Westminster, universities, &c. are denominated real privileges.

PRIVY, in law, a person having a share or interest in any action or thing. There are four kinds of privies mentioned by Coke: Privies in blood, as the heir to his father; privies in representation, as executors and administrators, of the deceased; privies in estate, as he in reversion, and he in remainder, donor and donee, lessor and lessee; and, lastly, privy in tenure, as the lord by escheat, that is, when the land escheats to the lord for want of heirs.

PRIVY-COUNCIL, a council of state, in which measures for the honour and safety of the realm are concerted by the king with his councillors, who are chosen by himself, and removable at his pleasure. Any natural born subject of Britain is capable of being a member of the privy-council, all that is necessary to constitute him such being the king's nomination; and immediately upon this, after taking the proper oaths for the security of the government, and the test oath for the security of the church, he is a privy-councillor till the king please to displace him. The oath of a privy-councillor consists of the seven following articles: 1st, To advise the king according to the best of his cunning and discretion; 2d, To advise for the king's honour and good of the public, without partiality, through affection, love, need, doubt, or dread; 3d, To keep the king's counsel secret; 4th, To avoid corruption; 5th, To help and strengthen the execution of what shall be there resolved; 6th, To withstand all persons who would attempt the contrary; and lastly, and, in general, 7th, To observe, keep, and do all that a good and true counsellor ought to do to his sovereign lord.

With advice of this council, the king issues proclamations that bind the subject, provided they be not contrary to law. A council is never held without the presence of a secretary of state. The officers of the privy-council are four clerks of the council in ordinary, three clerks extraordinary, a keeper of the records, and two keepers of the council-chamber. The privy-council consists of no definite number of members, this depending entirely upon the will of the king, who can dismiss any particular member, or the whole body, whenever he thinks fit.

PRIVY SEAL, a seal which the king affixes to such documents as are afterwards to pass the Great Seal. It is also sometimes used in matters of minor importance, which do not require the Great Seal.

PRIZE, a vessel taken at sea from the enemies of a state, or from pirates. Vessels are considered as prize if they fight under any other standard than that from which they have their commission if they have no charter, party invoice, or bill of lading aboard, if loaded with effects belonging to the king's enemies, or contraband goods. The prizes taken by ships of war are divided among the officers, seamen, &c. according to an appointment of his majesty by proclamation; but among privateers the division is according to an agreement made between the owners and the men.

PROA, FLYING, a vessel used in the South seas, which, with a brisk trade-wind, will sail nearly 20 miles in an hour. The proa is of a singular construction, the head and stern are alike, but one of the sides, intended to be always the lee side, is flat, while the opposite is round like that of other vessels; and to prevent her oversetting, which from her small breadth, and the straight run of her leeward side, would infallibly happen were it not guarded against, there is a frame laid out from her to windward, to the end of which is fastened a log, shaped like a small boat, and hollow. The weight of the frame is intended to balance the proa, and the log by its buoyancy to prevent her oversetting to windward. The body of the proa consists of two pieces joined endwise, and sewed together with bark, for there is no iron employed in its construction, and the sail is made of matting; the mast, yard, &c. are of bamboo.

PROBATE, of a will or testament, means the exhibiting and proving of last wills and testaments before the ecclesiastical judge delegated by the bishop who is ordinary of the place where the party died. There are two ways of making this probate, either by the party who exhibits the will taking an oath that it is the last will and testament of the deceased, or when besides his oath he produces witnesses to confirm it, after having summoned such as may pretend to have an interest in the goods of the deceased. The latter form of probate is usually resorted to when there is a fear of some dispute arising about the effects of the deceased.

PROBATION, in the universities, the examination of a student previous to his taking his degrees. It also denotes the year which a religious was obliged to pass in a convent, in order to give proof of his virtue and qualifications for being admitted a member of the establishment.

PROBATIONER, in the church of Scotland, a student in divinity, who producing certificates of good morals, and of having gone through the university classes with the approbation of the professor, is admitted to trials, in order to receive a licence to preach.

PROBLEM, a proposition wherein some operation or construction is required. See MATHEMATICS.

PROGRESSION. See *Algebra*, under MATHEMATICS.

PROJECTILES. See MECHANICS and WAR.

PROJECTION. See *principle of Universal Gradation*, under ASTRONOMY, Vol. I.

PROJECTION of the SPHERE. See GEOGRAPHY, Vol. III. p. 742.

PROMISE, in morals, a declaration of some intention which the individual who makes it is in honour and conscience bound to fulfil. Such promise can only be considered obligatory in the sense in which the promiser really meant it; and hence, if his honour and veracity may be relied on, his interpretation ought to determine any doubts which may arise when words or expressions of various import may admit of different meanings and interpretation. All such promises as are unlawful, or where performance is impossible, cannot be considered as binding; but, on the other hand, such as are not released, and have not been fraudulently obtained, must be held obligatory, although followed by consequences injurious to the person who made them. The man of honour, or the Christian, will never venture to falsify his promise, though he should even swear to his hurt. In point of obligation there is little difference between a simple promise and a promissory oath, as moral duty is equally concerned in both; and the only shade of difference is this, that the former may have been made without so much reflection as the latter, which must have been made avowedly uuder the immediate sense of the Divine Being solemnly called to witness a moral and sacred obligation. To that Being who is infinitely just, who ever lives to reward and to punish, and who knows the secrets of all hearts, the violation of a promise must appear as criminal as the violation of an oath.

PROPERTY, LITERARY. See LITERARY PROPERTY, Vol. IV. p. 594.

PROPORTION. See MATHEMATICS, Vol. IV. p. 764.

PROPORTIONS DETERMINATE are those unchangeable quantities in chemistry according to which elementary substances invariably combine in the formation of compound, organic, or inorganic bodies. Even in the writings of Pythagoras and Philo, this doctrine of determinate proportions, in chemistry, has obtained a place, and has frequently been alluded to, although it is only in modern times that it has been admitted as a truth completely established by numerous analytical experiments. Wenzel, a distinguished German chemist, demonstrated that the relative quantities of earth and alkalies, by which acids are neutralised, are exactly the same, whatever the acid may be which requires to be saturated. The same fact is confirmed by the experiments of M. J. B. Richter, as well as by those of the immortal Lavoisier, of Berthollet, Proust, Higgins, and many other eminent chemists, who have all contributed to establish this opinion. Dalton, in his new System of Chemical Philosophy, 1808, has proved that elementary substances combine in such determinate proportions, that a particle of the one unites itself to 1, 2, 3, 4, &c. whole particles of the other, and that every new addition is in a multiple ratio. Professor Berzelius of Stockholm, by an extensive and accurate course of experiments, without the view of establishing any pre-conceived hypothesis, demonstrated the existence of chemical proportions, and also that Wenzel's experiments corroborated this doctrine, and exactly coincided with his own. An account of these experiments was afterwards published in Nicolson's *Journal*, Tulloch's *Philosophical Magazine*, and Dr Thomson's *Annals of Philosophy*. According to Berzelius, the two great laws by which elementary substances combine are, first, if one substance combine with another in several proportions, the numbers expressing these are integer multiples of the smallest quantity of the second that the first can absorb; and hence, if the quantity of the second be = 6, the other determinate proportions must be 24, 36 48, &c.; and, secondly, if two oxidised substances combine, the oxigen of the one must be an integer multiple of the other. From these two laws, in as far as concerns inorganic substances, have been discovered all the phenomena of determinate proportions in chemistry, although these rules are not absolutely without some exceptions. Berzelius, in his Memoirs, remarks, that "whenever we begin to consider this matter, it is evident, at first sight, that the cause cannot be any thing else than of a mechanical nature; and the idea which seems most probable and best suited to the views suggested by experience is, that bodies are composed of molecules or atoms which combine one with one, 1, with 2, 3, 4, &c.; and the laws of chemical proportions appear to result from this principle, in a manner so clear and evident, that it seems strange how an idea so simple and rational should have failed not only to be adopted, but even to be stated, till our own age. Professor Berzelius has proposed signs for expressing the composition of a compound body, and likewise tables exhibiting the weight of the several radicles, together with the composition and weight of their oxides, an excellent specimen of which the reader will find in the Edinburgh Encyclopædia. Sir Humphry Davy, in his Elements of Chemical Philosophy, adopts the opinion of chemical proportions; but, in place of Dalton's *atom*, and Wollaston's *equivalent*, he uses the term *proportion*. This doctrine of chemical proportions has of late been adopted by Thenard, Gay Lussac, and other French chemists, and also by those of Germany, although the theory respecting the cause of these proportions, has not been so generally acknowledged.

PROSODY, that part of grammar which teaches the proper accent of syllables, the rules for determining their quantity, and the measures of verse. The two most important parts of English prosody are number and rhyme. See LANGUAGE and VERSIFICATION.

PROTEST, in law, where one openly declares that he does not yield his consent to the act or decision of a judge; and it is also that by which the holder of a foreign bill of exchange declares that such bill has been presented for payment; but has been dishonoured; also it is that act by which the master of a vessel, on his arrival from foreign parts, protects himself and his owners from any damage sustained in the goods or cargo in consequence of the stress of weather or violent storms.

PROTESTANTS, those Christians who relinquished the communion of the church of Rome in the 16th century, and their successors, now divided into a variety of denominations.

From an early period, many pious and zealous men, both within and without the pale of the Catholic church, had resisted the usurpations of the popes, and testified against the growing superstition. The Separatists labour under great disadvantage, having been grievously misrepresented by the historians of the age, stigmatised as Manicheans, and not unfrequently charged with high crimes and misdemeanours, as an excuse for the violence with which they were persecuted. To place their character in its proper light was the object of the learned Beausobre, in those researches which he published under the title of *Histoire du Manicheisme*, as preparatory to a history of the Reformation, which, however, was only partially executed. They were known by the names of Paulicians, from their alleged preference of the apostle Paul to Peter,—Bohemians, from the country of Huss,—Cathari, from their professed and indeed obvious purity of manners,—Bulgarians, from the region where they took up their residence when expelled from the east; and, latterly, when they penetrated further to the west, by the still more famous titles of Albigenses and Waldenses. Disgusted at the multiplied ceremonies of the church of Rome, some of them might go to an opposite extreme, rejecting all external forms of worship, and centring religion almost entirely in contemplation and practice. But their rites and confessions sufficiently prove that this mysticism was far from being chargeable on them all. The process of opposition assumed a better and more effective form, when that grand revolution took place, which is now generally and justly styled the Reformation. It originated in Saxony, and, from small beginnings, spread itself with amazing rapidity throughout all the provinces of Europe.

For a particular history of its commencement, the reader is referred to the article LUTHER. We shall here only briefly trace it in connection with other events, as Luther was not the sole agent in the work. This extraordinary man, a native of Aisleben in Saxony, was a monk of the Augustine order of Eremites, and professor of divinity in the academy of Wirtemberg. Roused by the preaching of indulgences granted by Leo X. he first raised his warning voice against the doctrine of indulgence, and then, in ninety-five propositions, publicly maintained at Wirtemberg on the 30th September 1517, exposed it to general reprobation. Partisans were soon formed on both sides. Leo X. at first regarded the controversy with indifference; but being informed by the Emperor Maximilian I. that it had assumed a very serious aspect, and that tumults had already been excited which were likely to increase, he deemed it proper to summon Luther before him.

At the instance of Frederick of Saxony, who claimed the jurisdiction of Luther, the summons was superseded, and a conference appointed at Augsburgh in 1518. At this conference, cardinal Cajetan, who had been constituted judge and arbitrator, attempted to proceed by authority; and the arrogance he displayed soon put an end to the project of reconciliation. An incidental controversy, which was carried on at Leipsic, in 1519, for some weeks successively, between Eckius, a doctor of the church, and Carlostadt, the colleague and companion of Luther, contributed still further to render the restoration of peace hopeless. Among the spectators of this ecclesiastical combat was Philip Melancthon, at that time professor of Greek at Wittemberg, a young man, but much respected both for his learning and amiable manners, who being fully convinced of the excellence of Luther's cause by the discussions which he then heard, was induced to take an active part in promoting the Reformation. While, in consequence of these and similar transactions, the authority of the Roman pontiff began to decline in Germany, it received a mortal wound in Switzerland, from Zuinglius, a canon of Zurich, whose extensive learning was accompanied with the most heroic intrepidity. He had begun to diffuse the pure evangelical light before Luther came to an open rupture with the church of Rome, but was now animated to bolder measures by the example of the Saxon reformer.

It was in June 1520, when a bull was issued against him by the pope, that Luther, foreseeing the consequences, voluntarily withdrew from the communion of the church of Rome, and became the founder of the Lutheran church. In a diet of the empire held at Spire, it was agreed that every prince should have the power of managing ecclesiastical matters in his own province as he thought proper, till a general council could be called, which proved to be the famous council of Trent. After various other diets had been held with the view of composing the differences in Germany, a second was assembled at Spire in 1529, where the former agreement was disannulled by a majority of votes, and a new decree issued, declaring every change in the established religion unlawful till the determination of the general council should be known. Against the decree six princes of the German empire, who were in the minority, entered a solemn *protest* on the 19th of April, to which thirteen imperial towns adhered, and hence arose the name PROTESTANTS, which, from this period was given to all who relinquished the communion of the once Catholic church. These princes were John, elector of Saxony; George, elector of Brandenburgh, &c.; Franconia, Ernest, and Francis, Dukes of Lunenburg; the landgrave of Hesse, and the prince of Anhalt; and the 13 imperial towns who, along with them, solemnly protested against the decree of the Emperor Charles V., which prohibited any further innovations in religion, were Strasburg, Ulm, Nuremberg, Constance, Rottingen, Windseim, Memmingen, Nortlingen, Lindau, Remplen, Heilbron, Wissemberg, and St. Gall.

Melancthon was employed by the Protestant princes to extend the articles of the churches which had embraced the sentiments of Luther; and thus the famous Confession was formed, which was presented to the Emperor Charles V. at the diet of Augsburgh, in 1530. About nine years before this, the light of the Reformation had spread throughout Sweden and Denmark, and the Lutheran was recognized as the national church. Between 1530 and 1540, Calvin began to occupy a conspicuous place among the Protestants. What, in distinction from the Lutheran, is called the Reformed church in France, Holland, and Switzerland, was modelled chiefly according to his views. In his Institutions of the Christian Religion, prefaced with an admirable address to the king of France, he had differed considerably from Luther on certain points, and had improved even the system of Zuinglius, who also differed from Luther on nearly the same points. This book was well received, and had an extensive circulation. He afterwards settled at Geneva, where, besides officiating as a pastor, he contributed greatly to confirm and advance the Reformation, by a most extensive epistolary correspondence, by numerous yet elegant publications, and by founding that famous school of divinity to which his celebrity attracted students from almost every part of Europe.

For the history of the introduction of the Reformation into England, see the reigns of Henry VIII., Edward VI., and Elizabeth, in the article BRITAIN, also the article NONCONFORMISTS. This change was first introduced into Scotland by Messrs Patrick Hamilton and George Wisheart in 1527; and though these and many others became martyrs to the cause, it was embraced by a great part of the nation before the close of 1557. It advanced under the fostering care of the Lords of the Congregation, and was rendered completely triumphant by the labours of John Knox and Andrew Melville.—See, on both the general and national history, *Mosheim* and *Milner*, *Robertson's* Scotland and Charles V.; *M'Crie's* Lives of Knox and Melville.

On the continent, the Protestants are divided into the Lutheran and the Reformed churches,—the former adhering to a modified Episcopacy, the latter Presbyterian. The Reformed churches were originally what is styled Calvinistic in their sentiments, but have long been divided, particularly in Holland, into Calvinists and Arminians. In France and Switzerland, even in Geneva itself, they are now greatly degenerated. The Brownists, who arose in Holland, commenced a new denomination, styled Congregationalists or Independents. With these may be associated the Anabaptists, as holding the same opinions in regard to church government. Socinians also claim the honour of being ranked among Protestants, though they reject two fundamental articles in all the Protestant creeds,—the divinity and atonement of our Saviour. In Britain the three great classes of Protestants, discriminated by their opinions of church government, are fully displayed, the Episcopalians, the Presbyterians, and the Independents. The established church of England is Episcopalian, though her articles seem to be partly Calvinistic. The established church of Scotland is Presbyterian, and adheres to the Westminster Confession of Faith, with certain specified limitations. From both churches there are seceders, who have left the communion, but not the forms or creed of the established church. Those from the church of Scotland now form a considerable body, though divided on points not easily understood. With them may be ranked the society of Cameronians, who style themselves the Reformed Presbytery. The Independents, who are more numerous in England than in Scotland, with all other denominations, including the Quakers, or Society of Friends, are styled Dissenters, as opposed to the very ecclesiastical constitution and forms of the established church. These have usually no written creed or confession.

The class of Christians which is included under the term Protestants is very extensive, comprehending Huguenots in France, the Refugees in Holland, the Episcopalians and Nonconformists in England, and the Presbyterians in Scotland, together with a numerous body in America. The Protestants in England, besides the Episcopalians, are the Presbyterians, the Independents, and the Baptists, general and particular, who are again divided among themselves into innumerable sects and parties, among whom are the Socinians, Arians or Unitarians, Supra and Sublapsarians, Calvinists, Sabellions, Arminians, Baxterians, Antinomians, Methodists, Quakers, Brownists, Pædobaptists, Universalists, Moravians, Sabbatarians, Sandemanians, and Swedenborgians; for an excellent account of which the reader is referred to Evans' Sketch of the Denominations of the Christian World, 11th edition. It is drawn up in a perspicuous and popular manner, and contains much information, and many candid, pious, and judicious reflections. Those who are desirous of having a more elaborate account of these sects may consult Rees' Cyclopædia, a work of great merit and utility. The numerous divisions among those who profess the Protestant religion have furnished the Roman Catholics with matter of triumph, as they have been thereby enabled to assert that the Protestant faith is destitute of the metaphysical characteristic of a true church, that of *unity.* Infidels have, indeed, availed themselves of the same circumstance, alleging that the Christian religion engenders division, animosity, and persecution, which allegations, it is to be regretted, have so strong a foundation in truth. The genuine principles of Protestants, however, and the spirit by which they ought to be actuated, are such as are eminently calculated to divest them of that rancour, bigotry, and malice, and of all those evils and lamentable abuses which are daily exhibited in many of those sectaries that are the most numerous and popular. On the subject of the Protestant religion, Chillingworth, in addressing himself to a Romish writer, judiciously observes, "Know then, Sir, that when I say the religion of Protestants is, in prudence, to be preferred before yours; as, on the one side, I do not understand by your religion the doctrine of Bellarmine, or Baronius, or any other private man amongst you, nor the doctrine of the Sorbonne, or of the Jesuits, or of the Dominicans, or of any other particular company among you, but that wherein you all agree, the doctrine of the council of Trent; so accordingly, on the other side, by the religion of Protestants, I do not understand the doctrine of Luther, or Calvin, or Melancthon, nor the Confession of Augsburg or Geneva, nor the catechism of Heidleberg, nor the Articles of the Church of England,—no, nor the harmony of Protestant confessions; but that wherein they all agree, and which they all subscribe with a greater harmony, as a perfect rule of faith and actions,—that is, the *Bible.* The Bible, I say, the Bible only, is the religion of Protestants. Whatsoever else they believe besides it, and the plain irrefragable indubitable consequences of it, well may they hold it as a matter of opinion, but not as a matter of faith and religion; neither can they, with coherence to their own grounds, believe it themselves, nor require belief of it of others, without most high and most schismatical presumption. I, for my part, after a long, and, I verily believe and hope, impartial search of the true way to eternal happiness, do profess plainly that I cannot find any rest for the sole of my feet but upon this rock only. I see plainly, and with my own eyes, that there are popes against popes, and councils against councils, some fathers against other fathers, and some fathers against themselves; a consent of fathers of one age against consent of fathers of another age: Tradition, interpretations of scripture, are pretended, but there are few or none to be found; no tradition but that of scripture can derive itself from the fountain, but may be plainly proved either to have been brought in, in such an age after Christ, or that in such an age it was not in. In a word, there is no sufficient certainty but that of scripture only, for any considering man to build upon. This, therefore, and this only, I have reason to believe. This I will profess; according to this I will live; and for this, if there be occasion, I will, not only willingly, but even gladly, lose my life, though I should be sorry that Christians should take it from me. Propose me any thing out of the book, and enquire whether I believe it or no; and seem it never so incomprehensible to human reason, I will subscribe it with hand and heart, as acknowledging no demonstration can be stronger than this; God hath said so, therefore it must be true. In other things, I will take no man's liberty of judging from him, neither shall any man take mine from me. I will think no man the worse man, nor the worse Christian,—I will love no man the less for differing in opinion from me; and what measure I mete to others, I expect from them again. I am fully assured that God does not, and, therefore, men ought not to require any more of any man than this, to believe the scripture to be God's word; to endeavour to find the true sense of it, and to live according to it." Whenever the genuine spirit of Protestantism shall have shed abroad its benign influence in the hearts of men, and shall regulate and direct their lives and actions, then will their professions, as well as their conduct, be uniform and consistent; but so long as they are actuated by a contrary spirit, animosities, and divisions, and bitterness must prevail, and bring upon the common cause of Christianity dishonour and disgrace. For a farther account of the tenets of the different sects among the Protestants, see ARMINIANS, CALVINISM, PRESBYTERIANS, QUAKERS, REFORMATION, RELIGION, and ROMAN CATHOLICS; see also, *An Enquiry into the Constitution, Discipline, and Worship of the Primitive Church*, (said to have been written by Sir Peter King, afterwards Lord Chancellor of England;) also an Original Draught of the Primitive Church, being an Answer to the *Inquiry*; and a Letter from a Parochial Bishop to a Prelatical Gentleman, with an Apology for the Church of Scotland, by Mr Willison of Dundee.

PROTRACTOR, an instrument for laying down on paper the angles of a field, composed of a semicircle of brass, the limb and circumference of which is nearly divided into 180 degrees. See MENSURATION.

PROVOST, or PREVOT, in the King's Court, a person whose office is to hold the king's stirrup when he mounts his horse; and as there are four belonging to this establishment, one of them attends monthly in his turn. Provost also denotes the chief magistrate in a city, or the president of a college.

PRUSSIA, an extensive kingdom in Europe, lying between 50° and 55° of north latitude, and between 6° 30′, and 24° of east longitude. It extends in length not less than 1200 miles, stretching in a line from south-west to north-east, or from the borders of France to the river Memel, which divides it from Russia, and its breadth varies from 70 to 350 miles, the greatest breadth being between the Baltic at Dantzick and the south of Silesia.

*Name.*—This region was known to the ancients, who mention various tribes that possessed it; and the amber, which here only was found in such quantities as to form a regular article of commerce, contributing very much to its celebrity. The name is generally supposed to be derived from Porussia; *Po* in the language of the country, signifying near, or adjacent, and Porussia signifying near Russia. Frederick the Great, in his *Memoirs of the House of Brandenburg*, sanctions such a derivation of the name. Yet, how plausible soever this etymology may appear, some have traced the origin of the name to a different source, and have supposed it to be obtained from Prusi or Pruzi, an ancient Sclavonic tribe.

*Divisions.*—Prussia, which was formerly a duchy, is now of greater size than at any former date; and the remark of Voltaire is very applicable, that its dominions stretch along the map of Europe like a pair of garters. The length, however, as stated above, is not continuous, there being no direct intercourse between the eastern and western provinces, without the intervention of other states. On the north, Hanover stretches a considerable way into the dominions of Prussia; and towards the south, the straits of Brunswick, Hesse-Cassel, Waldeck, Darmstadt, Nassau, and others, intercept the direct communication. It has territories, however, which form insulated spots in the centre of the dominions of other powers, such as Neufchatel, one of the Swiss cantons, as well as small detached portions in Saxony, Saxe-Weimar, &c. After the peace of 1814, the Prussian dominions were divided as follow: *East Prussia*, formerly Ducal Prussia, including the governments of Konigsberg and Gumbinne; *West Prussia*, or Polish Prussia, containing the governments of Dantzick and Marienwerder; *Posen*, formerly part of Poland, and including part of the late duchy of Warsaw, with the governments of Posen and Bromburg; *Saxony*, (obtained from the kingdom of Saxony in 1815,) containing the governments of Meresburg, Magdeburg, and Erfurt; *Brandenburg*, with the governments of Berlin, Potsdam, and Frankfort on the Oder; *Silesia*, including the governments of Breslau, Reichenback, Leignitz, and Oppeln; *Pomerania*, formerly possessed partly by Sweden and partly by Prussia, including the governments of Stettin, Coslin, and Stralsund; *Westphalia*, with the governments of Munster, Munden, and Arensburg; *Juliers*, *Cleves*, and *Berg*, formerly belonging partly to Westphalia and partly to the lower Rhine, including the governments of Dusseldorf, Cleves, and Cologne; *Lower Rhine*, with the governments of Aix-la Chapelle, Coblentz, and Treves. These governments, which are described under the proper heads in the course of this work, contain severally ten or twelve districts, or even more, denominated circles.

*General aspect.*—In the whole of Prussia there is nothing that can properly be called a mountain, though there are many diminutive eminences. The Hartz, in Saxony, the Riesenbirge and other large mountains in Silesia the Westerwald in Westphalia, and the Hundsruck in the Lower Rhine, merely form the boundaries or outskirts of the kingdom, and are consequently to be regarded as belonging to other states as much as to Prussia. In the eastern, and other parts of the kingdom, there are lakes of every degree of magnitude; and the whole Prussian territories are finely diversified by the numerous canals and rivers which intersect them in all directions. Brandenburg, with Pomerania, is a sandy and barren country, but Prussia Proper formerly abounded in woods, and displays superior fertility; a character which may be also extended to Prussian Poland, an immense plain. But Silesia, in particular, displays a beautiful diversity, being level and even, where watered by the Oder and its tributary streams.

The *soil* of Brandenburg and Pomerania is not very genial or fertile, owing in some measure to the want of cultivation; and even the space between Berlin and Potsdam has much the appearance of a wilderness; but the soil of Prussia Proper and Prussian Poland is loamy and fertile, producing every kind of grain and esculent plant that can flourish under such a latitude; and if agriculture were attended to, is susceptible of much improvement. Agriculture, however, is yet in its infancy in Prussia; so that farming can scarcely be regarded as a distinct profession, as in Britain. But wheat is very extensively cultivated throughout the kingdom. In Westphalia, Silesia, and other parts, flax is cultivated to a great extent. Hops, pease, beans, and tobacco are successfully cultivated, and wood is abundant in the eastern provinces. Among the productions of Silesia must be classed maize, and even vines, but the wine is of inferior quality.

*Climate and seasons.*—The climate of the Prussian dominions is, upon the whole, cold, moist, and ungenial, owing to the number of marshes, the extent of forests, and the inundations of the rivers and of the sea. So slight is the slop towards the sea in Pomerania, that were not the land protected by a long range of sand hills, or artificial dikes, it would be inundated by the tide to a great extent; and indeed, from the levelness of the surface, both in Pomerania and the other provinces, the rivers frequently inundate the neighbouring country, or expand into lakes of considerable dimensions. During the winter, which in some places lasts eight months, and even in autumn, rain is very common, and sometimes makes dreadful devastation. Cold predominates to a great degree in the eastern districts, and along the shores of the Baltic; but in the western and middle provinces the climate is remarkably mild and genial. In the several divisions of the country, the climate is so various, that in some parts summer seems to have arrived, while in others all the severity of winter is experienced by the inhabitants. Though the climate of Prussia cannot be considered as salubrious, endemic diseases are unknown in that country, and instances of longevity are by no means uncommon.

*Rivers and lakes.*—The rivers of Prussia are not only numerous, but are situated at so regular a distance from each other as to answer almost in an equal degree every district of the country. The chief of these are the Elbe, which rises in the Giant mountains, between Bohemia and Silesia, and empties its waters into the German ocean not far from Heligoland; the Oder, which has its origin in Moravia, and communicates with the Baltic by three mouths, forming the two islands of Wollin and Usedom; the Vistula, or Wesel, which rises in the Carpathian mountains, taking a northerly course, flows into the Baltic; the Pregel, in east Prussia; the Memel, or Niemen, which forms the boundary between Prussia and Russia; the Spree, which, by means of canals, unites the Elbe and the Oder. Besides these important rivers, there are many tributary streams, some of them very large, and navigable in a greater or less degree. Fish in great abundance and variety are produced in all the rivers, as well as along the shores of the Baltic.

Prussia, as we have already hinted, abounds in lakes, the chief of which are the Grass Haff, at the mouth of the Oder; the Frisch Haff, Cunsch Haff, and Spelding See, in East Prussia. The first of these lakes is thirty-six miles long, and from one to nine broad; the Frisch Haff is seventy miles long, varying in breadth from three to ten; the Cunsch Haff is sixty miles in length, with a mean breadth of ten miles; but of the numerous lakes in East Prussia the Spelding See is the most considerable, being 20 British miles in all directions. It is reckoned that there are 300 lakes in East Prussia, 160 in West Prussia, and about 680 in Brandenburgh, most of which are navigable to vessels of a greater or less size. In West Prussia, and other parts of the kingdom, the name of *Werder* or Merienwerder, signifying a drained marsh, or land surrounded by water, is of frequent occurrence; and it is therefore probable that lakes were even more abundant in former times than at present.

Besides the large navigable rivers, which afford Prussia a ready communication with the sea, there are various canals which connect the different portions of the kingdom with each other. By means of canals, there is a line of communication running at right angles with the rivers, from the eastern almost to the western extremity of Prussia, a distance of about 800 miles. Indeed, the internal communication by water which this country enjoys, with the industry and energy which characterize the Prussians, cannot fail to raise them, in point of internal resources, to an equality with the most opulent nations of Europe.

*Animals.*—Domestic animals are numerous throughout all the provinces of Prussia; and, besides the common game, there are deer, roebucks, wild asses, and bisons of great size in the forests. The breed of sheep has been much improved of late by the introduction of the Merino and Paduan rams; nor is the rearing of horses neglected, though the breed has not hitherto been brought to great perfection. In the uncultivated provinces of the east may be seen the marmot, a species of castor, and the lynx.

*Minerals.*—Prussia contains mines of copper and lead, and some considerable founderies of iron. In the Silesian mountains are found agates, jaspers, rock-crystal, calamine, cobalt, sulphur, saltpetre, alum, and vitriol. At Schweidnitz, in Lower Silesia, as also in some parts of Saxony and Westphalia, coal is to be found, yet it is not very extensively used as common fuel. The peculiar mineral production of Prussia is amber, which is chiefly found on the Samland shore of the Baltic, near Pillau, on a neck of land formed by the Frisch Haff, which seems to have been the principal seat of this mineral from the earliest ages. This mineral was of great value in ancient times, though it is now sold in Prussia for a few shillings per hundred weight. It adds about L.8000 to the royal revenue. This substance is employed for making trinkets, scented powder, a spirituous acid, and a fine oil used in varnishing. It is found at the depth of 100 feet, reposing on wood coal, in lumps of various sizes, some five pounds in weight and is often washed ashore in tempests. The only mineral water worth notice in the Prussian dominions is that at Warmburn in the south of Silesia.

*Population.*—The whole Prussian territories embrace an area of 104,656 square miles, and the number of inhabitants, according to the last census, amounts to 10,536.571, averaging 99 to a square mile. The province of Silesia contains 1992,598, Brandenburg 1.297,795, Saxony 1,214,219, Westphalia 1,074,079 Lower Rhine 972,724, Juliers, Cleves, and Berg 93,5 040, East Prussia 919,580, Posen 847,800, Pomerania 700,766, West Prussia 581,970.

The *principal towns,* an account of which will be found under their respective heads in this work, are, Berlin, inhabitants 160,000, Breslau 63,000, Konigsberg 55,000, Dantzick 45,000, Cologne 39,000, Magdeburg 29,000, Aix la Chapelle 27,000, Halle 25.000, Stettin 21,000, Posen 20,000, Potsdam 17,000, Elbing 17,000, Erfurt 16,000, Dusseldorf 14.000, Dresden 13.500, Treves 13,500, Brandenburg 12,000, Frankfort 12,000, Stralsund 11,000, Coblentz 11,000.

*Arts and manufactures.*—If we except the linens of Silesia, the manufactures of the Prussian dominions are of small importance. Though this manufacture is cultivated chiefly in Silesia, it is also carried on to some extent in almost every other quarter of the kingdom, especially in the provinces of Posen and Westphalia. In 1816, there were no less than

207,870 looms employed in the whole kingdom. Since the introduction of the Merino and Paduan breed of sheep, the manufacture of broad cloth, of a superior quality, has been extensively cultivated. Cotton works are established at Berlin, Erfurt, Elberfeld, and other places. The other manufactures of Prussia are leather, earthen-ware, glass, paper, tobacco, starch, potash, vitriol, beer, brandy distilled from the native grains, and musical, optical, and mathematical instruments, types, and watches. What Mr M'Culloch says in his *Essay on the Reduction of the National Debt*, in reference to Silesia, is applicable to the whole Prussian dominions. "The low wages of labour, the great industry of the inhabitants, and the cheapness of provisions, will insure the prosperity of its manufactures." The Prussians were roused to exertion by the French refugees, who, after the revocation of the edict of Nantz, in 1685, sought an asylum in this kingdom. In Brandenburg alone, the descendents of these refugees, who still remain a separate people, amount to 10,000. They still retain their original habits and principles.

Prussia enjoys many facilities for commerce, but her commerce can scarcely be said to extend beyond the limits of Europe. The greater number of her exports are conveyed in foreign ships, of which the British exceed in number those of all other nations taken together. Amber is, by nature, constituted a monopoly of the country; but fashion has rendered this branch insignificant. Among the considerable exports may be named excellent timber of all kinds, skins, leather, tallow, flax, and hemp; nor must the linens of Silesia be passed in silence, many of which are sent into Holland, and sold under the name of Dutch manufacture. In return, Prussia receives wine, and other products of more southern and favoured countries. Memel, in East Prussia, is the largest commercial city. The other most frequented ports are Dantzick, Konigsberg, Elbing, Stettin, Magdeburg, Colberg, Stoplo, Swinemunde.

*Constitution and government.*—The government of Prussia, which is too much of a military description, must be pronounced despotic, the people having no voice or influence in any of the affairs of the nation. Of late, however, the people have been awakened to various abuses, and to the necessity of electing a representative body, such as once existed under the name of States, in consequence of which, it is said, considerable improvements have been made in the executive branch of the government. The succession is hereditary, and the age of majority is twenty-one. In the king alone is vested the whole executive and legislative power. To a council, consisting of members of the royal family and of the ministers of foreign affairs, is nominally entrusted the administration of the finances, of justice, of public instruction, of trade, of the public debt, of police, and of war; but the president of this council, though the heads of the different departments are responsible to him, is solely directed by the king, by whom he is nominated. Besides the council of state now alluded to, there are provincial councils for the transaction of public business, namely, the superintendence of the police, the regulation of traffic, the collection of taxes, and the administration of the laws. In Prussia every department of the government is managed with the strictest regard to economy.

The present monarch, Frederick William III., forms one of the members of the Holy Alliance, and enters with eagerness into all the views by which that body is distinguished, and, in some respects, he carries despotism in his own dominions to a height which, in Britain, would be reckoned intolerable. He is, however, assiduous in promoting the best interests of his subjects. Several judicious improvements have been made by him in the legal code of the kingdom, and in the administration of justice. He has established the liberty of the press, and he has even promised a representative government to his subjects. With such advantages, the Prussians are making rapid progress in all the arts of peace and national prosperity, and are characterized by as much contentment, patriotism, and attachment to their sovereign and government, as they displayed at any previous period of their history.

*Laws.*—Frederick the Great formed the present code of laws upon the ancient manners and customs of the people; but this code was not reduced to a regular and complete system till the time of his successor. Courts are established of every gradation of dignity and authority. The decision of the lower courts is not final, except in cases of little importance. Appeals from these courts are made to the *Oberlandesgerichten*, which are established in each government, and the final appeal is to the High College of Justice in Berlin. The police department, which is under separate jurisdictions, is managed with much mildness and efficiency, every attention being paid rather to the prevention than to the punishment of crime. The superintendence of buildings, sewers, the supplies of water and of food, is entrusted to Boards which are instituted in the cities. Provincial consistories have the management of the affairs of the church. In several of the large cities a board of merchants is appointed, under whose direction commercial affairs are properly regulated.

*Revenue and expenditure.*—Prussia has the advantage of comparative freedom from national debt. Her present revenue is estimated at seven millions and a-half sterling, and is derived from taxes on the land, on persons, on patents and licences, on stamped paper, and on a custom duty on foreign productions. Nearly a third part, however, of the whole revenue is obtained from the royal domains, and other departments, namely, mines, coinage, game, posting. The king enjoys a considerable official income, yet, so little attention is paid by him to external splendour, or personal gratification, that it is said the annual expense of the royal household does not exceed the comparatively trifling sum of L.200,000. Though the Prussian monarchs have uniformly kept a powerful military force, economy in the management of the revenue has been with them a primary object of attention. The military establishment at present requires more than one-half of the whole revenue of the kingdom. Of the national debt of Prussia, which is estimated at L.26,000,000, a part, namely, L.6,000,000, is a loan from Britain. About a seventh part of the currency of Prussia formerly consisted of paper money, but gold and silver coin are now very generally in use.

*Military force.*—The number of Prussian troops, during the late war, exceeded 200,000; the present number on the peace establishment is about 160,000, exclusive of the militia, which are of two kinds, the *Landwehr*, consisting of men between 25 and 40 years of age, who, in time of war, are a disposable force, and the *Landstrum*, consisting of all males above 40 years of age, capable of bearing arms, who are called out only in cases of emergency, in order to maintain internal tranquillity. Every young man, when twenty years of age, is liable to serve in the regular army for a limited time. It thus appears that in Prussia almost all the males in the kingdom, who are of age, are either in the army, or are liable to be called out in cases of alarm. Perhaps the long and open frontier of the kingdom renders necessary such a state of preparation to avert danger. It is worthy of remark that the tactics of the late able sovereign conferred distinguished reputation on the Prussian battalions. In the late war, when led on by the veteran Blucher, (in himself an host,) they lost none of their reputation; they exhibited, on various occasions, an admirable display of military skill and bravery. The acquisition of Dantzick, and some other ports on the Baltic, may probably, in time, place Prussia among the maritime powers; but her sole attention hitherto has been devoted to the land service. The greatest portion of the kingdom makes a part of the Germanic Confederation, and maintains for its defence a stipulated number of troops.

*Ecclesiastical state.*—In Prussia there is no national religion; and there being no legal religion prescribed to the king, the present royal family are Calvinists. All religious sects here enjoy liberty of conscience; yet Lutheranism and Calvinism are most prevalent, though the Roman Catholic religion predominated before the recent acquisitions. There is, probably, no country in Europe more distinguished for Christian harmony in religious matters than Prussia, where the different sects seem to live in perfect concord one with another. On the occasion of the three hundredth anniversary of the Reformation, the Lutherans and Calvinists relinquished their characteristic distinctions, and united themselves into one body under the name of the Evangelical Confessions.

*Language and Literature.*—The ruling language of Prussia is the German, which it is probable may in time supplant the Polish in those parts that are subject to Prussia and Austria. The high German being the dialect of the Court, and of the higher classes in society, is invariably used in literary productions, in the courts of law, and in the churches.

Prussia is eminent for literature and the diffusion of liberal knowledge, and indeed it has been more or less so for centuries. The celebrated astronomer Copernicus, a native of Thorn, was born in the year 1472. Cluverius, a distinguished geographer, was born at Dantzick in 1580. Regiomontanus, (so called from his being a native of Konigsberg) whose real name was Muller, distinguished himself as one of the greatest astronomers of the 15th and 16th centuries. Wolff, born at Breslau in 1679, was eminent as a man of science, literature, and philosophy. Ramler the poet, Busching the geographer, Mendelsohn a Jew, celebrated as a polemical divine, Nicolai, a writer of romances, Spalding, Klaproth, and Humboldt, are well known to have flourished in Prussia: Nor must the name of Frederick the Great be omitted, who is not unworthy to be classed among the most distinguished writers of his kingdom, being more frequently spoken of and quoted as an author and as a patron of learning than in any other capacity. Frederick, who was a patron as well as a cultivator of literature, rendered essential service to his country by the establishment of schools in the various parts of the kingdom. The system of national education in Prussia is perhaps the most enlightened and effective to be found in Europe. In the capacity of a teacher, no young man can be received without a recommendation from one of the seminaries established for the proper instruction and discipline of persons designed to become teachers. "The school-tax," says Mr Adam, "must be paid by the lord and tenants without distinction of religion. The boys must all be sent to school, from their sixth to their thirteenth year, whether their parents are able to pay the school-tax or not. For the poor, the school money must be raised by collections. Every parent or guardian who neglects to send his child or pupil to school without sufficient cause is obliged to pay a double school-tax, for which the guardian shall have no allowance. Every curate must examine weekly the children of the school in his parish." In addition to the village seminaries, burgher schools and larger institutions called gymnasiums are established. There are 105 gymnasiums, each of which contains from four to twelve masters; the pupils in these great schools are taught the classics, mathematics, the modern languages, drawing, and similar accomplishments. Besides the universities of Berlin, Konigsberg, Breslau, Halle, Frankfort on the Oder, Geisswalde, and Bonn, there are a great many seminaries for instruction respectively in medicine, surgery, midwifery, natural philosophy, the veterinary and military professions, and theology. Learning and intelligence are diffused throughout every corner of Prussia by means of periodical literature, and every city has extensive libraries and museums. In Prussia, the number of books published is very considerable, and there are no restrictions on the importation of foreign works. Before any book can be published, however, it must be submitted to censors, an inspection which is merely nominal, except with regard to certain political writings which are liable to be interdicted. An unlimited right is enjoyed by the universities of printing all books without a previous censurate.

*Manners and customs.*—The inhabitants of Prussia are robust and industrious. They are a mixture of different nations comprehended under the denominations of Prussians, Poles, and Lithuanians. Some travellers have remarked, that in comparison with the Saxons, who are a lively and contented people, the Prussians appear dull and gloomy, a character which they impute partly to the military government, and partly to the general anxiety which must have been excited by the repeated dangers to which their country was exposed when contending with the powers of Russia and Austria. The Poles, again, seem full of life and action, though their features are rather Asiatic than European. Most of the Prussians and the nobility conform to the German manners and language, and exhibit in their character a regard to good morals, a reverence for religion, a thirst for knowledge, and loyalty to their sovereign. The nobility are nominally divided into the high and the lower nobility, the former being the descendants of those princes who were petty sovereigns in their own estates, and the latter are those who enjoy preferable claims to certain offices in the army, the state, or the church. The dress of the higher orders, both men and women, is remarkably elegant.

Among the Prussians there are several orders of knighthood, the most important of which are the following: *The Order of Generosity*, instituted, 1685, by Frederick, elector of Brandenburg, the first king of Prussia, who also on the day of his coronation at Konigsberg, in 1701 instituted the *Order of the Black Eagle*, with the motto, "*Suum cuique.*" Three orders, the *Order of Merit*, with the simple motto, "*Pour le merite*," instituted with the express design of rewarding meritorious persons, the *Order of St Stephen*, and the *Order of St John*, were instituted by Frederick the Great.

*Antiquities* can scarcely be expected to exist in a country where the arts and sciences were unknown till a comparatively recent period, and where neither the Romans nor any civilized people ever penetrated to leave behind them monuments of ingenuity. It is not surprising, therefore, that some Sclavonic idols, cast in brass, constitute almost the only pagan antiquities. The castles and churches erected after the introduction of Christianity have few singularities to attract particular attention. The Polish coinage begins about the twelfth century.

*History.*—The original population of Prussia appears, from Tacitus and Pliny, to have consisted of the Slavi or Sarmatae in the east and north-east, the Vandals on the shores of the Baltic or the north of Pomerania, and the Suevi in the remainder of the kingdom. These people, it is said, were very savage and barbarous, living upon raw flesh, and drinking the blood of the lower animals; they were even unacquainted with the method of constructing huts, and took up their dwelling in caves and cavities of rocks and trees. Among such a people it is vain to expect that any transactions would be recorded, or that any thing worthy of being recorded would be transacted. Indeed, little certain is known respecting them till the thirteenth century, when the Teutonic knights first obtained footing in the country. This celebrated fraternity originated in the year 1190, in the camp of the Crusaders before Acea or Acre, from some citizens of Lubec and Bremen. In the subsequent year a bull of institution was obtained from the Pope (Celestine III.) with all the privileges granted to the knights templars. The title of knights of the Teutonic order they derived from the name by which Germany their native country was called. The knights having been expelled with the other Christians from the Holy Land by Saladin, they directed their enterprise against the pagans of the north of Germany, A. D. 1227, and in a few years conquered Prussia, and founded several cities. They became troublesome to Poland, insomuch that the monarchs of that kingdom were sometimes obliged to carry on dangerous and bloody wars with them. About the year 1446, the four chief cities of Prussia, Elbing, Thorn, Konigsberg, and Dantzick, withdrew their allegiance from the Teutonic order, and claimed the protection of Poland. In 1466, Casimir king of Poland forced the Teutonic order to give up to him the eastern part of Prussia, and to pay homage for the western part. The last Grand-master of this fraternity was Albert marquis of Brandenburg, nephew to Sigismund I. king of Poland. The dignity was conferred upon him in hopes that his affinity to Sigismund might procure a restitution of some of the places which had been taken from the order during the former unsuccessful wars with Poland. Instead, however, of endeavouring to procure by fair means any favour from his uncle, Albert refused to do homage to him, and began to throw off his dependence, and to recover the whole of Prussia and Pomerania by force of arms. His enterprise proved abortive, and he was at length compelled to resign the office and dignity of Grand-master, in return for which the title of Duke, and the province he had enjoyed as Grand-master, were bestowed upon him by Sigismund. By the imprudence of Albert the interests of the order were destroyed, and he himself was obliged to consent to lay aside the habit and tenets of the Teutonic knights, to embrace Lutheranism, and to agree to hold his dominions as a fief of Poland. The fraternity being at length driven out of Prussia and Pomerania, transferred their chapter to Mariendal in Franconia; but in that and other provinces of the empire wherein they settled, little more than the name of the order, once so famous, now remains. The Teutonic order continued in Prussia till 1531, nearly three centuries after the time they obtained the grant of the territory of Culm, from Conrade, duke of Masovia, the competitor of Boleslaus V. for the crown of Poland. For a considerable time after this date, the Prussian annals are barren and uninteresting. Sigismund died in 1619, and was succeeded by his son George William; during whose government the electorate suffered the most miserable calamities. At this time the war commenced, between the Catholics and Protestants, which is commonly called the thirty years war. George-William acted a very weak and fluctuating part, and only sought to promote his own aggrandisement. He died in 1640, and was succeeded by Frederick-William, usually called the Great.

This excellent prince, though only 20 years of age at his accession, applied himself to repair the losses and destruction occasioned by the wars in which his father had been engaged. He concluded a treaty of peace with the Swedes, who evacuated the territories of Prussia which they had seized upon. He also paid 1400 crowns to the Swedish garrisons who possessed some of his towns; and he concluded a treaty with the Hessians, who delivered up a part of the duchy of Cleves; and procured of the Hollanders the evacuation of other cities. In the meantime the powers of Europe began to be weary of a war which had raged so long with unrelenting severity, and which was exhausting the sources of their dominions, without acquiring them any solid advantage in return. The conferences were opened at Osnaburg and Munster in 1645, and were not concluded till 1647. By the treaty of Westphalia, which serves as a basis to all the possessions and rights of the German princes, the bishoprics of Haberstadt, Munden, Magdeburg, and Camin were ceded to the duke of Prussia. A new treaty was then concluded with the Swedes for the regulation of limits, and for the acquittal of some debts, of which Sweden would only pay a fourth; and next year the electorate, Pomerania, and the duchy of Cleves were evacuated by the Swedes, who, notwithstanding these treaties, soon after invaded Pomerania, but without success. The elector in return, carried his victorious arms into Sweden, and gained many advantages over the enemy, when, by the interposition of the celebrated French generals Turrenne and Conde, a treaty, called the peace of St Germains, was agreed upon by the contending parties, the conditions of which were that the duke of Prussia should have the property of the customs in all the ports of Further Pomerania, with the cities of Camin, Gortz, Grieffenburg, and Wildenbruck, while he gave up to the Swedes all that he had conquered from them, and engaged to give no assistance to the King of Denmark, provided France would deliver up his provinces in Westphalia, and pay him 300,000 ducats, as an indemnification for the damage done to his estates. With this treaty terminated the military career of Frederick-William, who passed the remainder of his days in tranquillity. This justly celebrated prince died in 1688, carrying to the grave the esteem and regret of his subjects. Before his time Prussia was held as a fief of the Polish monarchs; but, in 1656, he compelled the king of Poland to declare it an independent state.

Frederick-William was succeeded by his son, Frederick I. who was proclaimed king of Prussia, at Konigsberg, on the 18th of January 1701, he himself placing the crown upon his head. The terms on which he obtained the regal dignity were, 1. That Frederick should not separate from the empire those possessions of his dominions which had formerly been dependent on it. 2. That in the emperor's presence he should not experience any marks of honour superior to those he had before enjoyed, but that his ministers at Vienna should be treated with the same distinction as those of other crowned heads. 3. That Frederick should maintain, at his own expense, 6000 men in Italy, in case the emperor should be obliged to make war on account of the claim of the house of Bourbon to the throne of Spain, and that the troops should be continued there while the war lasted. Thus was the kingdom of Prussia established, through the friendship of the emperor, with whom Frederick I. continued all his life in strict alliance. He was by no means unworthy of the honours he attained, though, during the course of his government, his extreme fondness for shew involved him in much expense. By preserving his dominions in peace, he consulted the true interest of his subjects much more than those monarchs who have dazzled the eyes of the world by their military exploits.

Upon the death of Frederick I. in 1713, his son, Frederick-William I. sometimes called Frederick II. obtained the sovereignty. This prince shewed himself in almost every thing, the reverse of his father. Being at once a tyrant and a miser, he delighted in the augmentation of his army, which was composed of the most gigantic men he could find, and in the accumulation of riches, with which he filled the cellars of his palace at Berlin. He was a great statesman, and his disposition was decidedly military, though he never engaged in actual hostilities. His army was the best disciplined and accoutred of any in Europe. In his reign Prussia first perceived her chief enemy and rival to be the house of Austria, and not France, as had been formerly supposed. Though some misunderstanding took place, war never was declared between these powers in the time of Frederick-William I. From the state, however, in which he left his army, and from the immense wealth he had accumulated, he put it in the power of his son to perform those exploits which astonished all Europe.

Frederick II. commonly styled the Great, succeeded his father in 1740. This monarch has been sometimes designated Frederick III., and, under this name, his life has been given in the order of the alphabet in this work; but as his father is more properly styled Frederick-William I. than Frederick II. we have here denominated him Frederick II. He was hailed by the people with joyful acclamations, and his reign was distinguished for many important transactions. Indeed, few princes ever attained to greater celebrity than Frederick the Great, or enjoyed more highly the affections of their subjects. The splendour of his military achievements, together with his literary attainments and performances, entitle him to be regarded as one of those extraordinary characters that occasionally arise to astonish the world. We shall here state briefly the more important events that marked his career. The first step taken by Frederick to increase his dominions was the invasion of Silesia, which was one of the principal causes of the hostility in which his future life was spent. Scarcely was the treaty concluded, by which the empress reluctantly yielded up Silesia, with a revenue of L.800,000 per annum, when she entered into another with the court of Petersburgh. The treaty of Petersburgh, as it was called, was apparently only defensive; but of six articles agreed to, one was, that, if the King of Prussia should attack the Empress Queen, or Russia or Poland, it should be held as a breach of the treaty of Dresden; and another contained a plan of a partition of Prussia to strengthen herself. In 1756, the queen also concluded a treaty with France. On hearing of these machinations, Frederick determined to be before-hand with his enemies. Accordingly, he entered Saxony with a powerful army, demanded a free passage for his troops, on the principle of the King of Poland's professed neutrality; which being refused, he blockaded the Saxon camp at Pirna. To oppose the two Saxon armies then in Bohemia, he sent one army under M. Schiveren, and another under the famous M. Keith. He soon joined the latter, and in a short time after attacked and defeated the Austrian general. On this, the King of Poland quitted his German dominions, while the Prussians took up their quarters in Saxony; and Frederick seizing the archives of Dresden, discovered the origin of the secret articles just alluded to, which, when published, proved the combination against him, and justified the measures he had taken in his own defence. Meantime, the circles were ordered to furnish their contingents; the French sent a large body of troops, the Austrians raised 100,000 men, and the Czarina sent 600,000 into Ducal Prussia, with a strong fleet to co-operate with them in the Baltic. The King of Sweden and the Duke of Mecklenburg also joined the combination, while Prussia had not a single ally except about 35,000 Hanoverians under the duke of Cumberland, who were soon forced to yield to a superior army of French under D' Etrees. In 1757, the Prussians entered Bohemia, and defeated an army of 28,000 Austrians. The Austrians then detached another body of 20,000 men from their main army, whereupon Frederick cut off all communication between that detachment and the main body; and having joined his two generals, attacked and defeated the Austrians near Prague; which city was immediately invested by the king, who began to bombard it from four batteries, which threw daily into it 288 bombs, besides a great number of red-hot balls, which set it on fire in several places. The garrison made a sally, but were repulsed, as were also 12,000 of the inhabitants who wished to get out. The king then raised the siege of Prague, left Bohemia, and retired into Saxony, where he was greatly harassed by the Austrians. The greatest cruelties were, in the meantime, committed in Ducal Prussia by the Russians. The Austrians entered Silesia, penetrated to Breslau, and besieged Schweidnitz, while another body of them took Zittau. An army of 22,000 Swedes entered Prussian Pomerania, and took Anclaur and Demmein. The same was done by the French at Halberstadt, and the old Marche of Brandenburg. The King of Prussia at length met at Rasbach with the united army of his enemies, which amounted to 50,000 men, whereas the Prussians did not exceed 25,000. The Austrians were defeated with immense loss, and night alone prevented their complete destruction. In Silesia, however, the Austrians, after a short siege, reduced Schweidnitz, and took the Prussian garrison, of 4000 men, prisoners. After the surrender of Breslau, and when all was going to wreck, Frederick, by a most rapid march, passing through Thuringia, Misnia, and Lusatia, entered Silesia, and gave battle to the Austrians, near Leuthen, where the enemy lost 6000 killed, 15,000 prisoners, and 200 pieces of cannon. Breslau immediately surrendered, with a garrison of 13,000 men, the Russians evacuated Ducal Prussia, the Swedes were driven out of Prussian Pomerania, and, to add to Frederick's good fortune, the French were now so ably opposed by the Hanoverians, that he had no more trouble from them. The king next laid siege to Schweidnitz, which soon surrendered to him; after which, making a feint of invading Bohemia, he suddenly burst into Moravia, overran the whole country, and laid siege to Olmutz, the capital, but without success. His army then marched into Bohemia, took the city of Konigsgratz, and laid the neighbouring districts under contribution. At Zorndorff, the king obtained a signal victory over the Russians, after which victory the Swedes made a rapid retreat. The year 1760 began with very unfavourable auspices to the king. Since October 1756, forty generals had been killed in his service, exclusive of those wounded or taken; most of his hardy veteran soldiers had fallen in battle, and their places were filled with raw inexperienced troops, unable to cope with the Austrians. To add to his misfortunes, a body of 15,000 Austrians, with the whole of the Austrians and Imperialists in Saxony, began their march, in consort with the Russians, to meet at the gates of Berlin,—the whole amounting to 40,000 men; and as no more than 16,000 Prussians could be raised, Berlin was left to its fate, and was obliged to pay 800,000 guilders, and 1,900,000 crowns, while the magazines, arsenals, and founderies were destroyed, all the military stores, cannon, and other arms seized; besides all which, many violences were committed, and the king's palace plundered and abused. On their return, the combined armies took Leipsic, Torgau, Meissen, and Wirtemberg. Halberstadt was laid under contribution by the French. In East Pomerania, the Russians besieged Colberg; in West Pomerania, the Swedes advanced, while the Austrians were ready to oppose the king with a superior army. In these alarming circumstances, Frederick determined to make one desperate attempt, and succeeded in gaining a victory over the enemy, the consequence of which was of no small importance. All Saxony, except Dresden, was recovered; the Russians raised the siege of Colberg, and retired into Poland; and the Swedes were driven out of Pomerania. Though these successes retrieved the king's affairs, they exhausted his strength, so that he was unable to make such vigorous attempts as formerly; and he had to endure a train of adverse circumstances, in the midst of which, however, his inveterate enemy, the Empress Elizabeth, died, and was succeeded by Peter III. his warm friend. Hostilities were now, therefore, suspended, and the affairs of Frederick began to improve. After the peace of 1763, he co-operated with Russia in the invasion and destruction of Poland, and found means to obtain a share of that kingdom when it was dismembered. This event was first contemplated and suggested by the king of Prussia, but carried into effect chiefly by the exertion of the Russian monarch. Austria took almost no active part in the hostilities which led to it, yet shared liberally in the partitions that ensued. Frederick died in 1786, at the age of 75, and was succeeded by his nephew, Frederick William II.

On his accession, this prince found himself possessed of the advantages of a full treasury, the finest army in the world, and subjects enthusiastically attached to the government. Being of a pacific disposition, however, he did not pursue the system of aggrandizement for which his family was so remarkable, and his reign passed on in peace, except a short campaign made into the territories of Holland in 1787, in support of the prerogatives of the prince of Orange, and the hesitating and unsuccessful wars with France during the years 1792, 1793, and 1794. Frederick-William was so improvident and extravagant in his expenditure, that he dissipated the immense treasures left him by his predecessors. He restored the German, the vernacular language of Prussia, to its natural rank and station, from which, for about half a century, it had been degraded by the French, and he strictly ordered all publications injurious to the interests of religion and morality to be suppressed.

The present monarch, Frederick-William III. succeeded to the throne on the death of his father in 1797. Nothing remarkable occurred in the early part of his reign, till 1806, when he formed an alliance with Bonaparte, and shared in his unjust spoils by invading Hanover and annexing it to his dominions, and by shutting the ports of the German sea, and of Lubec, against the British flag. Perceiving, however, the dangerous and precarious nature of his situation, he soon renounced correspondence with the emperor of France, the first consequence of which step was the battle of Jena, in which Prussia lost 40,000 men, including about 20 generals. From the unsuccessful war with the French, Frederick-William III., by the treaty at Tilsit, gave up the new acquisitions from Poland and his German territories west of the river Elbe. In consequence, however, of the successful termination of the German campaign at the close of 1813, all his lost territories were restored by the peace of Paris in 1814; and by some transfers and additions made at the congress of Vienna in 1815, Prussia was at once raised from the condition of a second rate power to be one of the first sovereign states of Europe, and rendered as formidable as she was in the time of Frederick the Great. The new territories conferred on Prussia, by the congress of Vienna, are as follow:—From France, the Lower Rhine, and part of Juliers, Cleves, and Berg; from Westphalia, Munster and the remaining part of Juliers, Cleves, and Berg; and from Saxony, Thuringia, Upper and Lower Lusatia, and Menneberg, which latter provinces are situated on the north and east of the Saxon dominions. About the same time, Prussia, partly by exchange, and partly by purchase, obtained from Denmark that part in the west of Pomerania called Swedish Pomerania, with the island of Rugen. See the articles AUSTRIA, FREDERICK III., GERMANY, POLAND, RUSSIA, in this work. See the following works by Frederick the Great: *Memoirs of the House of Brandenburg*; *Memoirs of his own Times*; *A History of the War of Seven Years*; and *A History of the Transactions from the Peace of Hubersburg*; See *Letters on Silesia*, by Adam, Minister-plenipotentiary from the United States, 1801; *Tableau de la Pologne*, par Malte Brun, Paris 1807; Reichard's *Guide des Voyageurs*. Weimar, 1805; *Statistische Darstellung der Preusische Monarchie*, von J. A. Demain, 1818.

PRUSSIAN BLUE. See CHEMISTRY and DYEING.

PRUSSIATES. See CHEMISTRY and DYEING.

PRUSSIC ACID. See CHEMISTRY and POISONS.

PSALM, a divine song or hymn. The name has long been restricted, in common use, to the inspired songs collected in one of the canonical books of the Old Testament. These are in number 150. They are styled the Psalms of David, the book having been begun and chiefly written by him. From internal evidence, however, as well as the titles of the Psalms, they appear to have been composed at different periods and by different individuals; one in particular is ascribed to Moses, for whose name in the title no criticism can account, otherwise than by regarding him as the writer, which is confirmed by the tenor of the psalm; others of them are inscribed with the names of the persons who were to sing them, as *Korah, Ieduthun*, &c.—*Psalmody* is the art or the act of singing psalms. It has always been held to be an eminent part of the devotional exercises sanctioned by revelation. The Jews and the primitive Christians were accustomed to sing psalms in the fields, and while employed in their daily occupations; nor was this thought to be strange even in the latter, as the heathen among whom they dwelt were wont to honour their gods and heroes by celebrating their praises in the same way. When performed as one of the stated acts of social worship, the practice was to sing in a standing posture. Sometimes the whole assembly joined in the song, at other times the service was performed by choirs, or the assembly were divided into two parts, who sung alternately, according to arrangements made and sufficiently understood. The use of musical instruments seems not to be so ancient as psalmody itself, but of very high antiquity. The circumstances of the primitive Christians did not admit of this practice, and it has not been enjoined under the Christian dispensation, as it seems to have been under the ancient economy. At what time organs were introduced into the Christian church, cannot exactly be ascertained. The first notice we have on the subject is about the year 666. See ORGAN. The *psaltery* was a musical instrument in use among the Jews, supposed to be a species of harp; but the term *psalter* signifies the book of psalms, or, among the Catholics, a rosary consisting of 150 beads, corresponding to the number of the psalms.

PSALMANAZAR, GEORGE, the fictitious name of a remarkable impostor. He was born and educated at a free-school in France, and afterwards in a college of the Jesuits. After acting as a tutor for a short time, he surrendered himself to a rambling life, which he contrived to support by almost constant and strangely successful deceptions. He first procured a certificate that he was of Irish extraction, and had left his country for the sake of the Catholic religion. He next pretended to be on a pilgrimage to Rome, and being unable to purchase a pilgrim's garb, he furtitiously abstracted one which he observed hanging in a chapel, and then proceeded to beg his way in fluent Latin. Having soon acquired a sufficient sum, he gave up the practice of begging, occupied his time in surveying what he thought worth seeing, resorted to the most comfortable inns, and in these spent his money as freely as he had obtained it.

His resources failing at length, he formed and executed a project which has excited the astonishment of the learned, and certainly shewed him to be a man of uncommon talents. Having heard much about the Jesuits of China and Japan, he conceived the idea of passing for a native of the island of Formosa, a convert to Christianity, travelling for instruction. To support this assumed character, he formed an entirely new language on grammatical principles, which like other oriental languages he wrote from right to left with great readiness. In connection with this, he planned a new religion, divided the year into 20 months, and devised many other novelties to impose upon the credulous. Having at length entered as a soldier into the Dutch service, and being still desirous of being looked upon as a Japanese, he altered his character to that of an unconverted heathen. At Sluys he procured an introduction through a Colonel Lauder to the chaplain of his regiment, who, in order to ingratiate himself with the bishop of London, offered to carry Psalmanazar over to England. Some surmises against his pretensions having been thrown out at Rotterdam, he adopted the whimsical resolution of living on raw flesh, roots, and vegetables. On his arrival in London, the bishop, deceived by this and other circumstances, countenanced and protected him with the most credulous humanity, so that he soon found himself in a circle of friends who looked upon him as a prodigy. Drs Halley, Mead, Woodward, and some others, were not so easily deceived; but all their efforts to expose his deceit only procured for him greater favour in other quarters. Having been urged to translate the church catechism into the Formosan language, he cheerfully undertook the task, and the manuscript, after being examined and approved of, was laid up as a valuable acquisition in literature. His history of Formosa elevated him still higher in the opinion of his friends, and he was rewarded, and sent to Oxford to study what he chose. The sceptics among the learned members of the university at length triumphed. Several very glaring absurdities were found out in his history, which were sufficient to discredit the whole narration. Finding it impossible to justify himself, and probably tempted by vanity also, or tiring of the fictitious character he sustained, he confessed to his particular friends that the whole was an invention of his own. By his learning and ingenuity, however, he was enabled to procure a comfortable support during the remainder of his life. He was afterwards engaged in several valuable literary works, particularly the Universal History, by which means, and by living for many years irreproachably, he in some measure redeemed his character. He died in 1763.

**PSYCHE**, in fabulous history, a young princess, and the favourite of Cupid, so extremely handsome that Cupid himself fell in love with her, and whose marriage with her has been celebrated by the poets. Psyche, in Greek, signifies soul. This favourite of Cupid was therefore represented with the wings of a butterfly attached to her shoulders,—for by the ancients the butterfly was considered as the emblem of the soul. When the Greeks, therefore, painted a dead body, they exhibited a butterfly near it, as if the soul had escaped from its mouth into the air.

**PSYLLI**, a people who, according to the ancient geographers, lived in the south of Cyrenaica, and were almost all overwhelmed in a tempest of sand from the desart. They are fabulously said by Pliny and others to have had something in their bodies so fatal to serpents, that the very smell of them was a charm against the most noxious of these creatures. The art of fascinating serpents is a secret among the Egyptians to this day, and the name Psylli is given to those persons who handle and sport with them without either fear or hurt. It might be supposed that the poisonous fangs are extracted, but this, creditable travellers inform us, is not the case. The efficacy of magic will not now be resorted to for explaining the phenomenon, though many superstitious rites are used by the performers. The only circumstances as yet known are the following; 1st, The secret is confined to certain families, who initiate none but their own children into it; 2d, The person who fascinates serpents never ventures his skill on other poisonous animals, nor meddles with them, such as scorpions, lizards, &c. There are some, it is said, who know how to charm these animals, but they again never meddle with serpents; 3d, Those who fascinate serpents eat them both raw and boiled, and even make broth of them; this dish they use particularly when they go out to catch them. At the same time, it must be remarked, that serpents are eaten both fried and boiled by many in Arabia and Egypt, who are not thereby qualified to charm them, and know nothing of the art of fascination; 4th, The charmers, after eating their soup, procure a blessing from their scheik, (priest or lawyer) who uses some superstitious ceremonies; among others, spits on them several times, with certain gestures. Much efficacy is ascribed to these rites, which assuredly can impart no power either of control over the creature or preservation from harm. We are naturally reminded of the most ancient account of this power in those styled the magicians of Egypt, who doubtless concealed the serpents somehow about their persons, into which they pretended to change their rods. In Ps. lviii. 6. there seems to be an allusion to a common mode of taming or rendering them harmless, which Chardin says is by breaking out their teeth. But the reference in the 5th verse to "the voice of the charmers," is more to the point, as an allusion to the power of music, which was often employed without resorting to any mutilation of the creature. The ancients frequently ascribe incantation even to the human voice. In *Apollonius Rhodius*, Media is said to have soothed the monstrous serpent or dragon which guarded the golden fleece, solely by her sweet voice. The laying that dragon asleep is by *Ovid* ascribed to the words uttered by Jason, *Metam.* lib. vii. 153. *Virgil* attributes the like effects on serpents to the song as well as the touch and art of the enchanter,—*Æn.* vii. 753. *Harmer* states, that adders will inflate themselves at the sound of a flute, and raise themselves up on the one-half of their body, turning about, and beating time,—*Obs.* Vol. ii. p. 223. *Teixeira*, a Spanish writer, in the first book of his Persian history, declares, that in India he had often seen persons leading about enchanted serpents, making them dance to the sound of an instrument resembling a flute, turning them about their necks, and handling them without any harm. *Niebuhr* witnessed the same thing in Cairo,—Trav. Vol. i. § 4. 10. The following extract is from *Mr Browne's* Travels in Africa, p. 83.—"The power of the charmers of serpents seems very extraordinary. The serpent most common at Kahira is of the viper class, and undoubtedly poisonous. If one of them enter a house, the charmer is sent for, who uses a certain form of words. I have seen three serpents thus enticed out of the cabin of a ship lying near the shore. The operator handled them, and then put them into a bag. At other times I have seen the serpents twist round the bodies of the Psylli, in all directions, without doing them any injury, though their fangs were not extracted." A curious, though terrific account of the practice has now become familiar to the public, in the amusing work entitled the *Scrap-book*. Those who wish to see ancient documents may consult Bochart's *Hierozoicon* on Serpents. The incantation of serpents has by many been treated as a fable, although both M. Savary and Mr Bruce affirm it as a certain fact. "I will not hesitate to aver," says Mr Bruce, "that I have seen at Cairo, and this may be seen daily without any trouble or expense, a man who came from the catacombs where the pits of the mummy birds are kept, who has taken a cerastes with his naked hand from a number of others lying at the bottom of a tub, has put it upon his bare head, covered it with the common red cap he wears, then taken it out, put it in his breast, and tied it about his neck like a necklace; after which it has been applied to a hen, and bit it, which died in a few minutes; and to complete the experiment, the man has taken it by the neck, and, beginning at the tail, has ate it as one would do a carrot or stock of celery, without any seeming repugnance." This author further affirms, that all the black people in the kingdom of Sennaar, whether Funge or Nuba, are perfectly armed against the bite of either scorpion or viper, and that the Arabs, from their infancy, acquire an exemption from the mortal consequences attending the bite of those animals by chewing a certain root, and washing themselves (it is not anointing) with an infusion of certain plants in water, so that at all times they can take the cerastes in their hands, put them in their bosoms, and throw them to one another as children do apples or balls, without irritating them so much as to bite. The art seems not to be altogether peculiar to the Egyptians, as an American lately exhibited his power over the rattlesnake in London and other places. Since music is not the sole means of fascination, it is probable the enchanters are acquainted with some drug which has influence on serpents, like the oil of Rhodium, Valerian, and other articles employed by rat-catchers for enticing these vermin from their holes to have them destroyed.

PTOLEMAIC *System of Astronomy*, so called because invented by Claudius Ptolemy, a celebrated mathematician and astrologer, who flourished at Alexandria in the second century of the Christian era, under the reigns of Adrian and Marcus Aurelius. By the Greeks he was surnamed *most divine* and *most wise*. There are still extant, his Geography, and several learned works in astronomy, of which the chief are the *Almagest*, the *Planisphaerium*, and his Treatise *De Judicius Astrologicis*. His system has now given place to that of Copernicus. See ASTRONOMY.

PTOLEMIES, kings of Egypt;—the first Soter or Lagus, a renowned warrior, an excellent prince, and a man of letters, who established an academy at Alexandria, and died 284 before Christ;—the next, Philadelphus, his second son, who succeeded him to the exclusion of his elder brother, Ptolemy Ceraunus, and was also renowned as a conqueror, but still more for his great virtues and political abilities. The names of these two are immortalized by the establishment of the famous Alexandrian library, which was begun by the father, and greatly augmented by the son. The latter granted considerable privileges to the Jews, from whom he obtained a copy of the Hebrew Scriptures, which he caused to be translated into Greek, and deposited in his library. Though the manner in which this work was executed be involved in obscurity, it is generally supposed to be what is now styled the Septuagint version, from the story that 70 or more persons were employed in forming it. Ptolemy Ceraunus was a very different character, and met with a deserved fate. On his exclusion from the throne of Egypt, he fled to Seleucus, king of Macedon, who kindly received him; in return for which, he secretly murdered him, and seized upon the crown. Having next prevailed upon Arsinoe, the widow of Seleucus, and his own sister, to share the government with him, whenever he got her in his power he also put her and her children to death. At length, he was himself overthrown, and torn to pieces by the Gauls, B. C. 279. See EGYPT.

PUERPERAL FEVER. See MIDWIFERY.

PUFFENDORF, SAMUEL DE, an eminent lawyer and historian. He was the son of Elias Puffendorf, minister of Fleh, a village in Misnia of Upper Saxony, where he was born in 1631. After acquiring the usual elements of literature, he prosecuted the study of the sciences with much success at Leipsic, but devoted himself chiefly to what is styled public law in Germany, the knowledge of the reciprocal rights of the empire, and of the princes and states of which it is composed. Though he endeavoured to excel in every science, and might have been graced with the highest title of honour at the university, he so far undervalued it as to refuse to accept it. Becoming tutor to the son of Mr Coyet, a Swedish nobleman, who was ambassador at the court of Denmark, he removed to Copenhagen; but the war being soon afterwards renewed between Denmark and Sweden, he was seized, along with the family of the ambassador, and placed in strict confinement for the space of eight months. Deprived of books and precluded from seeing any person, his only resource during that solitary period was reflection on what he had read in Grotius's Treatise *De Jure Belli et Pacis*, and the political writings of Mr Hobbes. The result of these meditations was a short system, which laid the foundation of his future celebrity. It was published at the Hague in 1660, under the title of *Elementa Jurisprudentiae Universalis.* Soon after the appearance of this work, the elector-palatine invited him to the university of Heidelberg, where he founded for his sake a professorship of the law of nature and nations, the first of that kind established in Germany. Thence he removed, on the invitation of Charles XI. of Sweden, to a chair established for the same purpose at Lunden, and from that time his reputation rapidly increased. Some years after the king of Sweden sent for him to Stockholm, and constituted him one of his counsellors and his historiographer. The elector of Brandenburg in 1688 prevailed upon his Swedish Majesty to invite him to Berlin to write the history of the elector William the Great. By him Puffendorf was elected to the dignity of a baron in 1694; but he died the same year in consequence of an inflammation in his feet, occasioned by want of caution in cutting his nails. He is the author of a Treatise on the Law of Nature and Nations, an Introduction to the History of the Principal States of Europe, a History of Sweden from Gustavus Adolphus's expedition into Germany to the death of Queen Christina, the History of Charles Gustavus, and other works.

PUGET, PETER PAUL, an eminent sculptor and painter. He was born at Marseilles in 1623, and indicating, early, a strong propensity to the imitative arts, he first acquired the knowledge of sculpture under Ronan, and then went to Italy, where he studied painting and architecture. In painting, he followed the manner of Cortona so successfully, that this celebrated artist desired to see him, and entered into a friendship with him. When only 34 years of age, a dangerous disorder compelled him to relinquish the pencil, and confine himself entirely to sculpture. In this department, his celebrity procured him an invitation to Paris, where he was appointed sculptor and director of the works relating to vessels and galleys, with a pension of 1200 crowns. Retiring to Marseilles, he died there in 1695. He was one of the greatest painters and sculptors France ever produced.

PULLEY, see MECHANICS.

PULO, the name of several islands in the Indian ocean, the principal of which, *Pulo-Condore,* is the only one said to be inhabited by natives. It is about 13 miles in length, and at an average about 3 miles broad, although, in some places, not more than one. The English at one time had a settlement here; and when Lord Macartney visited this island on his way to China, the natives, with much urbanity, welcomed a party from the squadron that went on shore, and conducted them to the residence of their chief. They were generally clothed in loose flowing garments, seemed honest, and were few in number, and very poor. Terrified at the arrival of such great ships, and such a powerful people, they fled and left their all at the mercy of the English, requesting the *great people* to pity them, and not burn their cabins. *Pulo Lingen* is another of these islands, but of small size, and chiefly remarkable for a mountain in its centre, which terminates like Parnassus, and is denominated by mariners the *Asses ears.* Pulo-Dinding is near the continent of Malacca, and belongs to the Dutch, who have a fort there. Pulo-Timoan is likewise on the eastern coast of the same peninsula, and abounds with trees, particularly the cocoa-nut and cabbage trees. It has several beautiful and fertile valleys, and the coast is plentifully supplied with green turtles. Pulo-Way, another island that lies near the coast of Sumatra, is the largest of those that form the entrance of the channel of Achem or Acheen, and is inhabited by exiles from Acheen. Pulo-Penang,—see PRINCE OF WALES' ISLAND.

PULTNEY, WILLIAM, descended from one of the most ancient families in the kingdom, was born 1682. He early obtained a seat in the House of Commons, and, in the reign of Queen Anne, greatly distinguished himself in Parliament as the opposer of Sir Robert Walpole and his ministry. On coming to the throne, George I. appointed him secretary of war, and, soon after, cofferer to his majesty's household. Mr Pultney, however, being suspicious that Sir Robert Walpole, who then acted as prime minister, was desirous of extending the limits of prerogative, and of favouring the house of Hanover, to the prejudice of the interests of Britain, he, on this account, opposed Sir Robert in all his measures to the utmost of his power, and by this means rendered himself so obnoxious to the crown that, in 1731, his majesty, with his own hand, struck out his name from the list of privy-counsellors. This measure, indeed, excited his resentment, but greatly added to his popularity with the people; and his eloquence and sarcasm against Sir Robert's measures were powerful and severe, so powerful, indeed, that Walpole was forced to resign his office in 1741. Mr Pultney was again replaced in the privy-council, and was, not long after, created Earl of Bath. By this elevation he entirely lost his popularity, but this loss he affected to despise. Towards the close of the war, in 1760, *in a letter to two great men,* which he published, he recommended proper articles to be insisted on in a treaty of peace. This letter went through several editions, and was much admired, though the author was at that time unknown. Having survived his only son, the title became extinct at his death in 1764.

PUMICE, a slag or cinder of some fossil, usually of a greyish or white colour. It is cavernous, of a spongy texture and silky lustre, opaque, though sometimes a little translucent at the edges. Its fracture is fibrous, the fragment is sharp-edged. It is the lightest of any body ranked among stones. Though rather soft, its particles in powder are very hard, which fits it for being used in grinding down metals, glass, ivory, &c. previously to polishing. Among the ancients it was used as a dentifrice, and is still sold for the same purpose. In the manufacture of leather it answers the purpose of smoothing. It is evidently produced by the action of fire, and is, accordingly, found chiefly in the neighbourhood of volcanos. We have it from Iceland, Italy, and Sicily. There are also considerable quarries of it in the Lipari islands. When found in other places, it has probably been supported by its lightness in the air, after being ejected, and thus carried by the winds to the sea, whence again it has been washed by tides on distant shores. See Geology.

PUMPS.—The general construction and uses of pumps, and the principle on which their action depends, have been explained in the treatise on Pneumatics in the present volume; and it is intended, in this article, to give a more particular account of some of the most important machines of this description in their most improved form.

Pumps are of three kinds, or denominations; *sucking*, *lifting*, and *forcing*, though the second may be considered a modification of the first.

The *sucking*, or common pump, consists of three principal parts; the *suction-pipe*, inserted into the well or reservoir; the *barrel*, forming one continuous tube with the suction-pipe, but of greater diameter, by about a third; and the piston, which moves up and down in the barrel, and permits the air and water to pass through it. The suction-pipe and barrel are often made of wood, bored within into the form of two unequal cylinders; but as that material possesses little durability, and is apt to give a bad taste to the water, it is now common to make them of cast-iron, and unite them by *flanges*, so as to be perfectly air tight. The end of the suction-pipe that is immersed in the water should be furnished with a grating, to strain the water from the impurities below; and at the lower end of the barrel is fixed a valve, opening upwards, and allowing the water to pass in that direction, while it prevents most of it from passing down again into the pipe, when the valve is closing. The valves used in ordinary sucking pumps are of that description called *clack* valves, and consist chiefly of a circular piece of thick leather, moving on a hinge over a collar of the same material, whose apperture is less than the diameter of the valve. As it is often necessary to take out the fixed valve in order to repair it, this apparatus is usually placed within a sort of conical box that shuts into a case of the same form, fastened to the barrel, and having a cross handle like that of a basket, by which the box can be raised with a long iron hook. Both the suction-pipe and barrel should be as straight as possible, and no longer than is absolutely necessary to raise the water to the proposed height, short of 32 feet. The bore of the barrel should be uniform and smooth, to obviate friction, and prevent the admission of air or water between the barrel and the piston.

The *piston* consists of a short hollow cylinder, commonly of wood, covered on the outside with leather, and having within it a valve similar to that already described, except that it has no box, and an iron rod, called the spear, to the lower end of which the cylinder is attached in such a manner as not to impede the motion of the valve, while its upper end is suspended to the extremity of a handle. The piston, thus formed, is sometimes made to work in a collar of leathers, to prevent the admission of the outer air.

The action of this apparatus is easily understood. The first part of the process of pumping is to depress the piston, so as to bring the two valves as near as possible together. In this operation, the air in the barrel is pressed on, and nearly the whole of it remains above the upper valve. When the piston is then raised, as the air in the barrel cannot return downwards, the air between the valves is expanded or rarefied, and is supplied by that in the suction-pipe, also in some degree rarefied. This rarefaction is increased by a second stroke of the piston; and the pressure of the air in the pipe and barrel being thus diminished, the outer air in the well or reservoir is allowed to exert its natural gravity on the water, and presses part of it up through the pipe into the barrel,—and this water, having no other means of escape, flows out through the side pipe or spout. The flow of water will depend partly on the velocity with which the piston moves, and partly on the length of the stroke. The former should not be less than is sufficient to carry the piston through four inches in a second, nor greater than to move it two or three feet. The stroke should be as long as possible, to prevent the loss of water through the valves.

The *lifting* pump may be regarded as the sucking pump reversed, and is used for raising water to a greater height than can be effected by the latter. In this pump, as the barrel is lowest, the piston rod must be of considerable length, and is very apt to bend by the force required to drive it through the water, and lift it up to the fixed valve, which, in these engines, is placed at the top of the barrel; but it has the advantage of accelerating the rarefaction of the air immediately above the water, and the ascent of the piston is comparatively easy. The flow of water from the side pipe is also more continuous, as it rises in the barrel during the descent of the piston.

The *forcing* pump differs from the sucking and lifting pumps, in having a lateral opening between the valve of the barrel and the lower end of the piston, and having this end solid, so as to form what is called a *plunger*. At the lateral aperture is a valve opening outwards, and from that opening proceeds a tube, through which the water flows from the pump. This is the simplest form of the forcing pump, and its action, in this state, is easily explained. The solid plunger, when depressed, having no cavity for admitting the passage of air or water upwards, *forces* the air downwards, and makes it pass into the lateral tube. On its reascent, the air below it is rarefied, and a few more strokes of the plunger increases that rarefaction so much, that the water rises into the barrel, and on the next descent of the plunger is *forced* to enter the lateral pipe, from which, without any other addition, it flows in successive jets. The plunger is formed of a double cone, rendered cylindrical in the middle by two collars of leather.

A double apparatus of this kind has been advantageously employed for raising water, in large quantities, to a moderate height of 11 or 12 feet, and is described by Dr Thomas Young. It is made by fitting two upright beams or plungers, of an equal thickness, through two cavities nearly of the same size, allowing them only room to move without friction, and connecting the plungers by a horizontal beam moving on a pivot. The water being admitted, during the ascent of each plunger, by a large valve in the bottom of the cavity, it is forced, when the plunger descends, to escape through a second valve in the side of the cavity, and to ascend, by a wide pipe, to the level of the beam. The plungers should not be tapered, on account of the great force which would be unnecessarily consumed in continually throwing out the water, with great velocity, as they descend, from the interstice formed by their elevation. This pump may be worked by a labourer walking backwards and forwards, either on the beam or on a board suspended below it. By means of an apparatus of this kind, described by Professor Robison, an active man, loaded with a weight of 30 pounds, has been able to raise 580 pounds of water every minute, to a height of 11¼ feet, for ten hours a day, without fatigue. This is the greatest effect produced by a labourer that has ever been correctly stated by any author; it is equivalent to rather more than 11 pounds raised through 10 feet in a second, instead of 10 pounds, which is a fair estimate of the usual force of a man, without any deduction for friction.

To render the flow from the lateral or *main* pipe of the forcing-pump continuous, as well as enable it to raise water to a greater height, there is attached to the farther end of the main pipe a hollow vessel, close at the top, except a perforation for receiving the pipe that is to throw out the water. This is called the *air-vessel*, because it contains air, by the compression of which the water is forced out in a long and continued stream. It is sometimes joined laterally to the main pipe, but is more commonly fixed so as to surround an interception of it. Now, it is evident, that when the main pipe is full of water, the next stroke of the plunger will force water into the air-vessel; and the water thus accumulated, pressing upwards against the air, will condense this fluid, and produce a corresponding counter-pressure on the water, in proportion as the quantity of water is increased. If a pipe, open at both ends, having its bore less than that of the main pipe, be fixed air-tight in the upper aperture of the air-vessel, into which it descends below the surface of the water, when sufficiently accumulated, the condensed air will press the water up through this pipe in a continued stream, and with a force proportioned to the condensation of the air. The continuance of the stream will depend on the smallness of the bore of the ejection-pipe in proportion to that of the main-pipe.

*Improved Lifting-Pump.*—The above description of the forcing-pump, will assist in explaining the action of an improved lifting-pump, contrived for the purposes to which forcing pumps are generally applied. In this pump the working barrel is similar to that of the sucking-pump; but near its top is joined a pipe, terminating in a rising main pipe like that of the forcing-pump, and the top of the barrel is closed with a strong plate, in the middle of which is a stuffing-box, for receiving the rod of the piston, and enabling it to work easily without admitting the external air, or allowing any water to escape that way. The valves of the piston and barrel are like those of the sucking-pump; but the main pipe has also usually a valve at or near its commencement. In its first operation, this pump acts like the common sucking-pump, except that, as the rarefaction of the air in the barrel and suction-pipe proceeds, this air is obliged to escape through the main-pipe, from which it is prevented from returning by the valve, so that the rarefaction is rendered more complete. In proportion as the water ascends into the barrel it is drawn up by the piston, and forced through the main pipe, from which it will flow with a velocity proportioned to that of the piston. One great advantage of this over the common lifting-pump is, that the piston-rod, from its shortness, and from its principal action being upwards, is not liable to be bent.

*Double pistons.*—In order to increase the power of pumps, and raise a considerable quantity of water in a short time, recourse has been had to the double piston, or rather two pistons attached to the same handle or lever, so that several persons may work it at the same time. This contrivance is particularly useful in fire-engines, and in the pumps used on board of ships. In these pumps, there is usually a standard for supporting the machinery. The pump has sometimes two barrels, each having a rising pipe for receiving the water, and a main-pipe for delivering it. The middle of the lever moves on a fixed pivot, and a piston is attached to each of its arms, and made to move equally in a vertical position by means of wheels working between vertical guides. These pumps may be made with a single barrel, so far divided by a partition that the pistons may work alternately, without interfering with each other, in which case one suction-pipe and one main-pipe are sufficient.

*Sea-pumps.*—In the ordinary pumps used at sea, the water is brought up to the main-deck, several feet above the load water line; by which a considerable part of the power is unnecessarily wasted, and the labour of the men increased. Mr Smeaton proposed to remedy this defect, by means of side pipes of wood, passing between the trunk of the pump and the sides of the ship, just above the load water-line, and furnished with valves, to prevent water entering the pipes, when the sea rose above its usual level.

Mr Witty has lately contrived a more simple and effectual method of remedying the same defect, by employing the power usually wasted in raising the water to the top of the barrel, as an additional force for carrying off the water. Instead of letting the water or liquid escape from a common pump at the usual place of delivery, he causes it to descend again in a syphon-pipe to the lowest level at which it can conveniently be delivered; and as this descent is considerable in ships, brew-houses, &c. a great saving of labour is effected, in working pumps of a descending column of water or liquor, counter-balancing as much in length of the rising column in the pump, as the height which it descends in the syphon-pipe to the place where it can be delivered. There is no doubt that this invention will be found of great practical value, as it relieves the men at the pump of a very great part of their labour. In cases of danger at sea, it may prove the means of saving both the ship and the crew. If it be considered that the water which, in ordinary pumps, falls from the top of the barrel to the place of its reception, is a mechanical force which is lost, we may avail ourselves of it by various contrivances for assisting the work to be performed. In Mr Witty's improvement, the men at the pump raise the water to the bottom of the

Pumps.

syphon, and it is then drawn through the syphon by the action of the longer branch. There are many cases in which the men may be allowed to raise the water to the top of the barrel, and employ the direct force of the descending fluid to work another pump, or perform any other piece of work that may be required.

*Chain-pumps.*—Large ships have commonly seven pumps fixed in the same well. Three of them are hand-pumps of the usual construction, and the other four are of the kind called chain-pumps. These latter are very powerful machines, allowing several men to work at them together, and delivering a great quantity of water in a short time. Instead of a piston, there is an endless chain, on which are strung pieces of leather or little shallow buckets, placed at regular distances, and made to fit the inside of an upright barrel, sufficiently close to prevent the water from escaping without producing too much friction. The most approved chain-pump is that of Mr Cole, in which each link of the chain is formed of two long iron plates, bolted together at each end, and the buckets are circular plates of brass, with a piece of leather between each pair of them. The sprocket wheels, which give motion to the chain, are made like the trundles of a mill, consisting of two iron wheels fixed on an axle, at the distance of eight inches from each other, and joined by several round bolts, over which the chain passes, and is prevented from sliding back by hooks, which fix upon the bolts as the chain is drawn round. The chain may be taken up to be repaired or cleared of shingle or other matters, by which these pumps are occasionally choaked. By means of this pump four men may easily raise a ton of water in about 43 seconds, so that these machines are very effectual in reducing an ordinary leak.

*Brown's Pneumatic Engine.*—At the close of the treatise on Pneumatics in this volume, allusion was made to Mr Brown's atmospheric or pneumatic engine, intended as a substitute for the steam-engine, both in raising water and giving motion to machinery. At the time that treatise was printed, the writer of it was not in possession of sufficient information, to give an accurate account of this ingenious contrivance; but the deficiency may very properly be supplied in the present article. The body of the engine consists of two cylinders in which the vacuum is to be produced, and each of which has a rising main-pipe, leading from the reservoir to the top of the cylinder. There are two pipes for conveying coal or oil gas from a gasometer, and one of these pipes passes into the cylinders, and terminates in perforated burners, while the other ends in small openings furnished with sliders in the side of the cylinders, and opposite to these are lateral jets communicating with one of the burners. The reservoir is filled with water, which passes through a pipe, and raises a float, which raises a rod, and thus elevates one end of a beam similar to that of a steam-engine. The top of each cylinder is furnished with a cap, which may be raised or let down according to the motion of the beam; so that as the ends of the beam are elevated or depressed, the corresponding cap is raised or lowered. By opening stop-cocks, gas is admitted into the pipes, and as it proceeds from the jets it is inflamed, and as the rod removes the slider, the fire is communicated to the burner, and thence to the cylinder. A glass vessel, containing mercury, is placed in the upper part of the apparatus, and so adjusted, that the motion of the rod alternately raises and depresses that vessel, and, by this alternate oscillation of the vessel, motion is given to other subordinate parts of the engine. In the position just described, the pipe, on the elevated side of the beam, is closed by a slider drawn over it, while the pipe on the other side is opened, so as to admit water to that side; and, by a similar process to that already described, the other end of the beam is elevated.

When one of the cylinders is covered with its cap, the gas is burning within it, and thus destroys part of the included air, and produces a vacuum, so that the water rises through this main-pipe, and nearly fills the cylinder. As after a vacuum has been produced in the cylinders, the caps are pressed down by the external air, it is necessary to introduce a little fresh air to enable the beam to raise them, and there is a contrivance for that purpose. The air is admitted just after the water has risen in the cylinder.

Part of the water received into the cylinders serves to keep them cool; but the greatest part is carried off through pipes to a trough, from which it is delivered, through a sluice, to the buckets of a water-wheel, and thus the wheel is put in motion, which it imparts to any kind of machinery fitted to its axis. When the engine is intended to act as a pump, the water-wheel is not necessary. For a more minute description of this machine, illustrated by a plate, see Brewster's *Journal of Philosophy*, Vol. I.

According to Mr Brown, his engine may be applied to most of the purposes for which steam engines are employed, and has the advantage of being considerably smaller, so that an engine of this kind will not weigh more than $\frac{1}{5}$ of a steam-engine of the same power. Respecting the principle of its action, some disputes have arisen among the chemists and machinists of the day. It was formerly supposed that the vacuum in the cylinder was produced by a sudden explosion of the gasses; but it is now generally agreed that it is the effect of a slow combustion.

It does not appear that this invention has as yet been brought into public use, either as a stationary machine in manufactures, or as a moving power in ships or carriages, and the great expense of the gas employed in working it, and the room occupied by the apparatus for preparing that gas, must always be serious objections to its use.

Purbeck.

PURACE, an Indian village of New Grenada, about 10,000 feet above the level of the sea. It is situated near the cataract of the river Pusambia, styled also Rio Vinagre, because its waters are strongly impregnated with oxide of iron, muriatic, and sulphuric acids. The scenery and other natural phenomena of this lofty plain of the Andes are described by M. Humbolt, who visited it in 1801.

PURBECK, isle or peninsula of, between Stutland and Weymouth, celebrated for its quarries and oviform limestone. It is ten miles long, and six broad, and is nearly surrounded by the sea and the river Frome.

PURCELL, HENRY, an original genius, and eminent master of music. He was born in 1658, and soon rose to great eminence in his profession. Towards the close of the reign of Charles II. he was made organist to Westminster abbey. In the reign of William, he set several songs for Dryden's Amphitrion and his King Arthur, which were received with much applause. His style was very different from the Italian; masculine, and perfectly English. So admirably did he adjust his notes to the words, that they became an echo to the sense, and the very sounds themselves seemed capable of representing the piece. He died at the age of 37, and was interred in Westminster abbey, where a monument is erected to his memory. Most of his works have been published under the title of *Orpheus Britannicus.*

PURGATORY, a supposed receptacle of souls after death, where Papists hold they remain till purified by their sufferings from those venial or pardonable sins of which they have not obtained remission in this world. It is distinguished, in the Roman Catholic system of divinity, from the *Limbus Patrum,* (or border of the fathers,) a place on the confines of heaven, where the spirits of the Old Testament saints are supposed to have resided, without being admitted to all the felicities of celestial glory, till our Saviour opened the gates of Paradise for them by his death. This dogma, however, like that of the *Limbus Infantum*, or receptacle of infants, seems to have been devised for the purpose of sustaining the doctrine of purgatory, as many plausible things could be alleged in support of the former, while the latter was found to be rather less susceptible of proof, even from the opinions of the fathers, not to speak of the Scriptures. Many of the heathen believed that departed souls underwent a certain purification in the sun or some other region of the universe, ere they were received into the plenitude of bliss, or reunited to God. To those who are acquainted with the oriental system of philosophy, and the mythology of the Greeks and Romans, the notion of purgatory will manifestly appear to be of heathen origin. Boughton has endeavoured to shew, that it has been held by Pagans, Jews, and Mahommedans, as well as by professed Christians. Middleton points to it as a part of the conformity to paganism, which popery would establish, for the purpose of rendering Christianity more acceptable to the heathen. Similar statements may be found in Puffendorf's history of the Spiritual Monarchy. But what chiefly recommends the doctrine of purgatory, is, that it is one of the most lucrative articles to the Romish clergy, who are liberally paid for masses and prayers for the souls of the dead. The doctrine is thus stated, that purgatory is a subterraneous place over the hell of the damned, where such souls as have not yet made satisfaction to divine justice expiate their sins by a purgation of fire, proportioned in degree and duration to the magnitude of their sins, unless they are speedily liberated by paying the priest for the requisite prayers and masses. If there was such a place as purgatory previous to the Christian dispensation, it is strange that, among the numerous rites of the Mosaic economy, neither prayers nor oblations were appointed to be offered for the dead. One proof supposed to be direct is adduced by the doctors of the Romish church; but is unhappily taken from the apocryphal books, and from a writer in these who candidly disclaims inspiration,—the historian of the Maccabees. The number of passages quoted from the New Testament has an imposing appearance. Protestants complain of this grand array, as more calculated to deceive the ignorant and create trouble to a respondent, than to convince the intelligent and judicious enquirer. The strongest is doubtless the phrase employed by our Saviour, Matt. xii. 32, which seems to imply that there is forgiveness in the world to come as well as in this. But Protestants consider the phrase as simply a distributive mode of expression for *never,* as it is interpreted in Mark iii. 29. Bishop Horsley supports the idea of an intermediate state between death and the resurrection, in a sermon on Christ's preaching to the spirits in prison, 1 Pet. iii. 18.; but distinguishes his opinion clearly from that of the Romish church, which he confutes. Protestants, in general, consider that passage as referring to Noah's ministry among the antediluvians prior to the incarceration of their spirits, and hold that only two states after death are mentioned in Scripture,—that of the righteous, who are represented as "with Christ," or "present with the Lord," on becoming "absent from the body;" and that of the wicked, who then "lift up their eyes in hell."—See *Catechism of the Council of Trent*; *Bellarmine's Works*; *the Confutation of Bellarmine,* by Ames; and a popular work, entitled, *The Protestant.*

PURITANS, a translation of the word *cathari,* the name given, in reproach, to many who separated from the Romish church, after what they deemed idolatry and superstition began to prevail,—professing to follow the pure word of God, in opposition to all human institutions and traditions. The designation refers to the rigid morals they professed and exemplified. In excellence of character they far surpassed those by whom they were traduced and persecuted. The name was revived in the reign of queen Elizabeth, and was applied to the Protestant exiles who returned to England on her accession to the throne. These not satisfied with the reformation effected by the queen, wished to carry on this work even further than the ecclesiastical laws required. Her majesty, and those who acted with her, were willing to retain many of the Popish ceremonies, and desired only the restoration of king Edward's liturgy; whereas the exiles, holding the Popish habits and ceremonies in abhorrence, refused to conform to the usages of the old establishment, loudly declaimed against them, and endeavoured to introduce the worship and discipline of the foreign churches in France, Holland, and Geneva. Though the name was given them in derision, it was founded on the acknowledged severity of their morals, the care with which they avoided the corruptions of the age, and the zeal with which they testified against them. They did not avowedly separate from the church, expecting at first, doubtless, to accomplish the reformation

Purple.

they wished within her pale; and on finding this impracticable, they were still willing to remain on the principle of non-conformity to her ceremonies and discipline. At this the queen connived for a time; but no sooner was she firmly established on the throne, than she showed her aversion to the Puritans, by instituting the High-commission court, which had power to suspend ministers from their livings by a decision founded on the canon law, and not on the statutes of the realm. This court, composed of three commissioners of the queen's nomination, instead of producing witnesses, administered an oath, by which the accused was obliged to answer all questions which might be put to him, however prejudicial to his own interest. "If he refused to swear," says Neal, "he was imprisoned for contempt; if he took the oath, he was convicted on his own confession." These unjustifiable measures, and the persecution carried on against them during the reigns of Elizabeth and the Stuarts, drove the Puritans once more to seek refuge abroad. Many of them went to America and formed colonies in Massachussets, Rhode Island, Providence, New England, and other places. In some of these places they displayed a spirit of intolerance which showed they had not profited as they ought by their own hard treatment. Hume, though he occasionally sneers at their religious principles and manners, expressly affirms, "that the precious spark of liberty was kindled and preserved among the Puritans alone; and that to them the English owe the whole freedom of their constitution." See NONCONFORMISTS and PROTESTANTS: see also Dr Toulmin's edition of Neal's *History of the Puritans*, and Palmer's *Non-conformist's Memorial*, two works of no small merit.

PURPLE, a colour composed by a mixture of red and blue, in various shades. That of the ancients was the production of a marine shell-fish, caught in the Mediterranean, and of which Bochart endeavours to prove there were three species, differing in the tincture they afforded. According to Pliny and others, it was necessary to take and bruise them alive, as they were apt, in dying, to vomit out the juice which was in such requisition. It was probably in this trade that Lydia was employed at Phillipi; Acts xvi. 14. To be invested with *the purple*, or to assume it, was to become emperor among the Romans. The appropriation of this colour to "the vesture" or long flowing robe of kings, seems to be of high antiquity. In the book of Judges, the sacred historian enumerates, among the spoils of Israel, the "purple raiment that was on the kings of Midian." The Jews made a decree, that Simon should wear purple and gold, and that none of the people should wear purple, or a buckle of gold, without his permission, in token that he was their chief magistrate; 1 Mac. xiv. 43. In this they seem only to have imitated the nations around them. Thus Homer describes a king.

> "A robe of military purple flow'd
> O'er all his frame; illustrious on his breast
> The double clasping gold the king confessed."
> *Odyss.* xix. 261. POPE.

For other details, see the articles DYEING and HERALDRY.

Putney | Putrefaction

PURPURIC ACID, the name of a new acid, for the discovery of which we are indebted to Dr Prout. It may be obtained from lithic acid by chlorine. But the preferable process is to digest the chrystals of the purpurate of ammonia with caustic potash till the red colour disappears, and then gradually drop the alkaline solution into sulphuric acid, which, uniting with the potash, leaves the purpuric acid in the form of a yellow powder, which is utterly destitute of taste or smell. Dr Prout conceives that the purpuric acid may constitute the basis of many animal and vegetable colours, and might probably be combined successfully with some other purpurates as a paint.

PUTNEY, an English village in Surrey, on the Thames, about four miles from London. It contains above 490 houses and 2880 inhabitants. The only things remarkable are a wooden bridge over the Thames, which cost L.23,975, and yields a revenue of above L.3000 per annum; and an obelisk on the common, to commemorate Hartley's invention for securing buildings against fire.

PUTREFACTION, the spontaneous process by which the soft parts of animals and vegetables are decomposed, and resolved into certain gaseous and volatile substances, which mix with the atmosphere. It differs from chemical solution, as the agent which dissolves the body does not appear to combine with it, but merely to separate the parts from each other. It is generally supposed to be the last stage of fermentation; but though the vinous must precede the acetous, and this again, in ordinary process, the putrid fermentation, putrefaction will take place where there has been neither vinous nor acetous fermentation, and therefore appears to be independent of and unconnected with them. It does not, like vinous and acetous fermentation, produce any new and permanent result; nor is it, like these, always accompanied with evolution of heat. Putrifying substances are exceedingly dangerous: but it is not well ascertained in what the poison consists. As in fermentation, there is manifestly an extrication of fixed air; but neither this, nor the vapour of volatile alkali, to which some have ascribed the danger, are detrimental to the human frame. So virulent, however, is the poison, that when received into the lungs it has been known to produce putrid fever; and when admitted, by cuts or scratches, into the blood, it has proved mortal in a few hours. A man who cut his hand in flaying a putrid sheep, became himself a putrid mass in less than 24 hours. Very unpleasant consequences have also been experienced from such accidents by anatomists. But a few years ago, a German chemist died of infection by a scratch on his hand in the preparation of Prussic acid. Even taken into the stomach, putrid matter is detrimental. It is said, indeed, that a putrid egg is of all animal poisons the most rapid when allowed to remain, and is apt to produce intolerable sickness even when disgorged. The mummies of Egypt shew that the ancients were acquainted with some process by which putrefaction might be to a great extent prevented or counteracted. Bodies will not putrify *in vacuo*, because a certain quantity of air is requisite to the process, but at the same time free exposure to the air retards, as the confinement of the putrid effluvia accelerates it. Heat, too, is requisite, and therefore extreme cold renders the process remarkably slow, and seems in some cases to suspend it altogether. Though water in burying-grounds retards it, yet some degree of moisture in the body itself is necessary, for if it be very dry the texture is too firm to be speedily acted upon by the decomposing principle. Oils and gums prove antiseptic by excluding the air; salts, acids, and ardent spirits, again, by hardening the texture of animal substances. Many vegetables also produce the last effect by their astringent qualities, and thus also serve powerfully to resist putrefaction. Sugar, though neither acid nor alkaline, is one of the most effectual antiseptics, probably owing to its strong tendency to the vinous fermentation, which is incompatible with putrefaction. Nitrous air, and fixed air, on the same principle by which they extinguish flame, are remarkably antiseptic. Much is by some ascribed to the *aroma* of certain drugs, though this probably serves only to counteract the offensive smell of putrifying matter.

Sir John Pringle made a number of experiments for ascertaining the antiseptic power of various substances. Assuming sea-salt for the standard, or No. 1, he found sal gem, vitriolated tartar, spiritus Mindereri, and soluble tartar = 2, sal ammoniac = 3, nitre, salts of hartshorn, and wormwood = 4, or rather more, borax = 12, salt of amber = 20, alum = 30. Myrrh, aloes, assafœtida, and terra Japonica = 30. Of all resinous substances, camphor was found to resist putrefaction most powerfully. Sir John rates its antiseptic power 500 times greater than that of sea salt. Infusions of large quantities of mint, angelica, green-tea, red-roses, common wormwood, mustard, and horse-radish, were stronger than the standard, but at what ratio was not evident. Chamomile flowers, Virginia snake-root, pepper, ginger, saffron, and contrayerva-root, were equal to borax, twelve times more powerful than salt. Sugar not only resisted the commencement of putrefaction, but checked it when begun. Port-wine, small-beer, infusions of bark and bitter vegetables, retarded fermentation in flesh and bread; an unstrained decoction of bark considerably increased it. It is probably with bark as with sea-salt, different and even opposite effects depending on the quantity used, although its action seems also to be modified by other circumstances. One dram of salt was requisite to preserve two drams of beef 30 hours uncorrupted; 25 grains of salt had little sensible effect; but 15, and especially 10 grains, were found to accelerate and heighten the putrefaction, softening the flesh more than pure water would have done. Dr Macbride's experiments shew, that the putrefaction of mixtures of animal and vegetable matters is accelerated by additions of absorbent earths and of Peruvian bark. On the other hand, in a French essay towards a history of putrefaction, the experiments of the author go to prove that metallic salts, resinous powders, and extracts of bark and opium, are powerfully antiseptic. Putrefaction is promoted by unburned calcareous earth, chalk, crabs' eyes, and other absorbent powders. Quicklime and lime-water are antiseptic; but they as effectually destroy the texture of animal substances as putrefaction itself. In blood the tough inflammatory crust was found to be most putrescent, next to that the crassamentum, and, least of all, the serum. See CHEMISTRY.

In 1793, Mr John Donaldson obtained a patent for a new method of preserving animal and vegetable substances from putrefaction. It consisted of a paste of wheat or barley-meal and a solution of common gum or vegetable mucilage, made into a paste and baked in an oven of a moderate heat; and when the dry mass is reduced again to powder it is then fit for use. The vegetable, or flesh, either raw or dressed, is then packed in wooden boxes, surrounded with this powder, and completely secluded from the air.

PUY, the chief town of the department of the Upper Loire in France. It is ill built, and, excepting its large cathedral and picturesque situation, has little that is attractive. Dyeing is carried on to a great extent; and there are considerable manufactories of blankets, silk, lace, linen, and stone-ware. Population 15,920.

PUY DE DOME, a department of France in Lower Auvergne, bounded on the north by the department of the Allier, on the east by that of the Loire, on the south by those of Upper Loire and Cantal, and on the west by those of Correze and Creuse. It contains about 428 square leagues. Watered by the fine streams of the Allier, the Dore, the Sioule, the Dolore, the Couze, and the Veyre, it is extremely fertile, abounding in corn, vines, and fruits. Paris receives large supplies of oxen from its rich pastures. Brandy and nut-oil are manufactured in great quantities, and of fine quality. The cheese produced is also said to be delicious, and in much request. About 600 tons of iron, and 12,000 of coal, are yielded annually. There are veins of lead ore, and quarries of marble. The forests cover more than 96,000 acres. Population 509,444. Clermont is the principal town.

PUZZULANA, or POZZOLANA, a kind of earth thrown out by volcanoes in the form of ashes, sometimes in such quantities as to cover whole provinces at a considerable distance. It abounds in the kingdom of Naples, about Puteoli or Pozzuoli, Baiæ, and Cumæ. It is of a loose porous texture, and usually mixed with heterogenous substances. It is slightly magnetic, indicating the presence of iron, and on this may depend its celebrated power as an ingredient in mortar; its distinguishing property being, that when mixed with one-third of its weight of lime and water, it hardens suddenly, and forms a cement which is more durable under water than any other.

PYGMALION, in fabulous history, a king of Cyprus, who, observing the dissolute lives of the women of that island, and feeling disgusted with their conduct, resolved never to marry; but, having formed a female statue of ivory, he became so passionately in love with it, that, on the festival of Venus, he prostrated himself at her altar, and entreated her to give him a wife exactly resembling his beloved statue. Returning home, he, according to custom, embraced the statue, but was surprised to find it gradually become sensible, and change into a living maid, whom he espoused, and by whom he had a son, who was named Paphos.

Pyramid.

**PYRAMID**, in geometry, a solid figure upon a triangular, square, or polygonal base, and terminating in a point at the top, by the regular inclination of the sides to this vortex.

The same term has long been given to those stupendous erections in Egypt, which extend in a line from Cairo to the north, on a plain of about fifty miles, parallel to the Nile. See EGYPT.

Many unsatisfactory conjectures have been formed, and theories adopted, with regard to their use. Pyramids have been reared for the purpose of preserving the memory of singular events, or transmitting to posterity the glory and magnificence of princes. Such is the pyramid erected in Holland in honour of Bonaparte, 110 French feet high, exclusive of an obelisk in the summit, which is 42 feet more. As 30,000 men assisted in this undertaking, it was completed in 32 days. The idea, however, was obviously suggested by the pyramids of Egypt, and these, like that of Cestius at Rome, are generally supposed to have been intended for funeral monuments. That they contain sarcophagi seems to be established by all travellers who have visited them. It must therefore be allowed that this was a use to which they were put. Herodotus states, that the Egyptians considered the pyramidal form as emblematical of human life, the broad base on the earth representing the commencement, and the gradation to a point the termination of our existence. We should have thought the interpretation of the emblem more natural and just, had it been inverted. This is, however, the reason he alleges for their being used for sepulture. The shape, too, it is said, was the best for rendering a tomb everlasting, as the least liable to be affected by rain, tempests, or earthquakes. But Egypt is not liable to these, and the pyramids are founded on a rocky base. If they were intended merely for funeral monuments, it is strange that no inscription has recorded the names of those to perpetuate whose memory they were erected, and strange that the process of embalming was not used to preserve the bodies deposited in the stone coffins or receptacles of the dead. The bones found in them are the bones of animals, and they do not all contain what are denominated sarcophagi. The practice was rather to bury in catacombs, many of which have been opened and explored by travellers. But granting that the animals whose bones have been found in the pyramids might have accidentally entered and perished in them, or been lodged there on principles of superstition, and granting that the dead bodies once entombed, and the sarcophagi, may have been abstracted, at some time or other, from the chambers which are now empty, still it will not follow that the only design of these immense fabrics was to be sepulchres of kings,—nor is it natural to suppose that the vanity which could rear them would adopt no method for transmitting to posterity the names which they were intended to immortalize. That they were erected for astronomical purposes, is but a fanciful and foolish conjecture, disproved by the circumstances enumerated in our article EGYPT. Still less were they adapted to the purpose of granaries as others have supposed. Mr Gabb, who has published an elaborate treatise on this subject, supposes them of antediluvian origin, that they were at first intended as a standard of measure, and that the chest in the interior was for a standard measure of capacity, as its length was for linear measure. The French Scavans are of the same opinion, as appears from Denon's Travels.

Pyramus.

In this uncertainty of conjecture, the following idea has been submitted to the learned: that the pyramids were originally intended to remedy the disadvantage of the Delta, and particularly Upper Egypt, by attracting the clouds, and eliciting a discharge of rain. Volney has attempted, in one of his works, to prove that the ancients in Egypt, and the East, were not unacquainted with the phenomena of electricity, though they designated the fluid by other names. But, supposing their knowledge of this and of its identity with lightning to be very imperfect, the fact was sufficiently obvious that mountains and elevated grounds attract clouds, and occasion a discharge of rain. Immense masses of vapour pass regularly from the Mediterranean to the mountains of Abyssinia, without shedding a drop of rain on the plains of Egypt. To arrest these, if possible, and induce them to part with at least some of their moisture, was an object of great importance,—was likely to preserve or redeem much ground otherwise lost,—and to save much trouble in cultivating that which still owed its fertility to the waters of the Nile. The level of the plain was broken by the stupenduous masses raised and crowded together upon it,—the best substitute for mountains within the compass of human power. It has been stated that, after the introduction of thunder-rods into Italy, and their very general use, the quantity of rain in that country was considerably increased. The pointed form of the pyramid might be deemed best suited to the purpose intended, supposing the Egyptians acquainted with the principles of electricity; but their knowledge of these, or of facts in meteorology, was not sufficient, it seems, to suggest what would have been more likely to gain their object,—the erection of lofty metal rods on the top of the pyramid, or even the raising of masses of iron or copper to be placed in the upper chambers, and rest as a coping on the apex. This conjecture as to the use of the pyramids may be considered as in some measure sanctioned by the relation of the sphinx to the fertilizing of Egypt by the waters of the Nile. Representing the head and bosom of a woman, with the body of a lion, as we perceive from the form of other sphinxes in Egyptian architecture, it was neither a commemorative monument, nor connected with the rites of sculpture, but designed to symbolize the annual inundation, which takes place while the sun passes through the signs of the zodiac denominated the Virgin and the Lion. See SPHINX.

**PYRAMUS**, in fabulous history, a youth of Babylon, who, falling deeply in love with Thisbe, a most beautiful nymph, and his immediate neighbour, found the means of conversing with her through a chink of the wall, without the knowledge of her parents, who disapproved of their marriage. Tired of this restraint, they at length resolved to steal from home by night, and to meet under a mulberry tree that grew by the side of a certain brook. Thisbe having first arrived at the place, beheld a lioness besmeared with blood coming to quench her thirst, and sought for safety in flight; but dropping her veil, it was discovered by the beast, who tore it with her bloody jaws. Pyramus, arriving soon after, found the rent and bloody veil, and having observed the footsteps of the savage animal, rashly supposed that she had been torn in pieces by a wild beast, and, in a fit of despair, plunged his sword into his body, being resolved not to survive her. When Thisbe supposed the ferocious animal might be gone, she returned from her place of concealment, and finding the body of her beloved Pyramus, embraced it in her arms, and beheld him open his eyes and expire. Then seeing her veil, and the sheathless sword, she plunged it in her own bosom, that she might accompany him in death. The blood streaming from the wounds like a fountain on the mulberry tree near which they were slain, is said to have stained the berries, which were white before, and turned them to a purple hue.

PYRENEES, or Pyrenean mountains, the range which extends from the Mediterranean to the Atlantic, and forms the boundary between France and Spain. It is above 200 miles in length, and about 100 at its greatest breadth. Canigou was formerly supposed to be the greatest elevation, but is found to be only 9247 feet high, while the Pic D'Ossono rises 11,700 feet, and Mont Perdu is more than 12,000 above the level of the sea. Some glaciers occur, only of less magnitude than those found among the Alps. The mountains are for the most part covered with wood. The lofty peaks have a bleak and sterile appearance, but even these are in some places interspersed with fertile valleys. There are five passes, all of them very difficult.

The name PYRENEES, is given to three departments in the south of France; the *Eastern*, bounded on the south and west by the Pyrenean mountains, and on the north by the department of the Aude, containing about 220 square leagues; the *Lower*, bounded on the south by the same mountains, on the west by them and the sea, on the north by the departments of Landes and Gers, containing 409 square leagues; and the *Upper Pyrenees*, forming the eastern boundary of the Lower, having the mountains on the south, the department of Upper Garrone on the east, and that of Gers on the north, and occupying 250 square leagues. The chief town of the first is Perpignan; Pau is the capital of the second, and Tarbes of the third. The number of inhabitants corresponds to the size of the departments, the population of the Eastern being reckoned at 117,760, that of the Lower at 384,000, and that of the Upper at 206,680. The productions are in all the departments nearly the same, corn, wines, brandy, figs, chesnuts, maize, millet, silk, honey, and flax. Among the minerals, besides iron, copper, lead, and coal, are calamine, marble, and alabaster. But few manufactures are carried on. Cattle are exported in great numbers to Spain. The valleys of the Upper department, stretching into the very heart of the Pyrenees, exhibit much sublime and romantic scenery.

PYRITES, fire-stone, from the Greek word signifying *fire*, a mineral substance, consisting of iron in combination with sulphur. See GEOLOGY.

PYRMONT, a town of Lippe, in Westphalia, Germany, and capital of a district of the same name. It stands in a fine valley, has many good houses, and a well fortified castle, kept by a governor under the counts of Waldeck. The chateau of the prince is a great ornament to the place. Pyrmont, however, is chiefly celebrated for its acidulous chalybeate springs, which, from an early period, have been the resort of vast multitudes of strangers. The gay season commences about the end of June, and the company are most numerous in July. They drink the waters in the morning at six, breakfast at nine, dine about 12. There is a fine promenade formed by rows of lime trees, about 500 feet long, and 40 wide, to which the company repair after an early dinner. Population about 2000.

PYROLIGNOUS ACID, or wood vinegar, is merely the acetic acid combined with a little empyreumatic oil and bitumen. Billets of wood, chiefly cut branches of trees, as abounding most in sap, are ranged in the still, and subjected to the action of fire till they are reduced to charcoal. The liquid which comes over is the pyrolignous acid, having the same odour with red-herrings, as it is in fact the very principle of their preservation by the process of smoking with wood. Meat or fish immersed in it for a few seconds will keep for a long time. It proves destructive, however, if the period of immersion be not regulated according to the size and quality of the substance. At one time it was expected to be of much service for preserving flesh on long voyages. It is much used in printfields for fixing the colours. A fine transparent vinegar is also prepared from it for the table; but this has been found ill suited to the purpose of forming pickles or preserves, as it is apt, in process of time, to decompose the articles on which it is poured.

PYROLITHIC ACID, the name of a new acid obtained from the white plates which sublime from uric acid distilled in a retort. When a solution of these is poured into a solution of the subacetate of lead, there falls a pyrolithate of lead; when it is washed, it may then be decomposed by sulphureted hydrogen gas. The liquor which swims on the surface, by evaporation, produces the crystals of pyrolithic acid.

PYROMALIC ACID, the name of another new acid, the crystals of which are obtained by evaporation from the liquid which passes over into the receiver when malic or sorbic acid is distilled in a retort.

PYROMETER, from the Greek signifying *fire* and *measure*, an instrument for measuring degrees of heat above those which can be indicated by the mercurial thermometer. See CHEMISTRY.

PYROPHORUS, also compounded of two Greek words *to bear fire*, is a chemical preparation which has the property of taking fire as soon as it is exposed to atmospheric air. A good pyrophorus for common use may be made by calcining three parts of alum with one of wheat-flour, in a phial, till the blue flame disappears. This is preserved in the same phial with a good stopper. On exposure to the air the sulphuret attracts its moisture, and produces a degree of heat sufficient for igniting the carbonaceous matter combined with it. See CHEMISTRY.

PYROTECHNY. See FIRE-WORKS.

PYRRHO, a Greek philosopher who flourished about 300 years before Christ. He was born at Elis in Peloponnesus, and made hunting his profession before he devoted himself to the study of philosophy. Becoming a disciple of Anaxagoras, he accompanied his master as far as India, and afterwards established a new sect, known by the name of Pyrrhonists or sceptics, whose fundamental principle is to doubt every thing. They held that we can judge only by appearance, that appearances always deceive us, and that therefore we cannot attain certainty about any thing.

PYRRHUS. See EPIRUS.

PYTHAGORAS, a celebrated ancient philosopher who flourished in the 47th olympiad, about 590 years before Christ, supposed to have been born at Samos according to some, and at Sidon according to others, though the learned are much divided respecting both the time and place of his birth. He was educated at Samos, where his father had his principal residence, but found no teacher there capable of satisfying his thirst of knowledge. The fame of Pherecydes drew him first to the island of Scyrus, whence he went to Miletus for the purpose of conversing with Thales. The early part of his history is involved in great uncertainty. After studying for a short time again under Cresphilus, who had been his first master at Samos, he is said to have travelled into Phœnicea and stayed for sometime at Sidon. Thence he passed into Egypt, where, through the favour of Amasis the king, he was admitted into the colleges of the priests, after performing a number of ceremonies, among which was that of circumcision. For twenty-five years, he applied himself to the study of the astronomy and geometry of the Egyptians, and made himself master of all the opinions and facts involved in the mysteries of that singular people. He then travelled to Babylon for the purpose of adding to his stores the knowledge of the Chaldeans. There he is supposed to have conversed with Ezekiel and Daniel, but he does not seem to have borrowed much from the system of the Jews. Brucker indeed disputes the fact of his visiting Chaldea, and thinks he returned directly from Egypt to Samos, there to communicate the intellectual treasures he had amassed. Finding the Samians not inclined to set much value on them merely as the acquisitions of a philosopher and traveller, he repaired to Delos, where he presented offerings to Apollo, and pretended to have received from the priestess certain moral precepts, which, with this divine impress, his countrymen were more willing to adopt. He had also visited Crete to converse with the priests of Cybele, and was there by Epimenedes initiated into all the mysteries of Greece. At Sparta, too, he was instructed in the laws of Minos and Lycurgus. From Peloponnesus he went to Italy, and spent some time at Heraclea, but made his chief residence at Crotona, where he was very successful in reforming the manners of the inhabitants.

The tardy manner in which the due measure of respect was conceded to him by the Samians, probably suggested the idea of assuming something of a divine character, which he prosecuted too far for a philosopher. In the school which he opened at Samos, he delivered moral precepts to the multitude, while in a secret cave he taught the abstruser part of his system to select disciples. Syloson, the tyrant of Samos, refusing to countenance his high pretensions, drove him from the land of his fathers. Among the colonies of Magna Grecia, he tried to secure respect by even pretending to the power of working miracles. In Crotona he established a society of 600 persons, who united their individual properties for the benefit of the whole. His followers almost regarded him as a divinity. The manner of his death is not well ascertained. Some say he was burnt at Crotona with many of his disciples; others, that having escaped from the flames, he was pursued out of the city and killed in a field of beans. Justin seems to insinuate, that, after having lived twenty years at Crotona, he died in peace at Metapontum. The more probable account seems to be, that the powers of Magna Grecia, incensed by the changes he seemed likely to produce even in politics, and disgusted with his pretensions to more than mortal wisdom, opposed his schemes, and compelled him to retire to Metapontum, where, being also pursued by his enemies, he took refuge in the temple of the Muses, and perished of hunger, about the 80th year of his age.

He prescribed to his scholars the rules of the Egyptian priests, and made them pass through the severe noviciate to which he himself had been subjected. He enjoined them two years silence in the school, (five years if he found them much inclined to be talkative,) during which period they were only to hear. After this they had leave to ask questions, propose doubts, or converse on any subject, provided they would say "much in few words." He adopted the three styles employed by the Egyptians, the simple, the hieroglyphical, and the symbolical, preferring however the last. He forbade the eating of flesh, taught the transmigration of souls, delivered admirable precepts in morality, and inculcated many excellent maxims for civil and political conduct. God he considered as a soul diffused throughout all nature, from whence human souls emanated. These he regarded as immortal, and taught that, though vice might occasion transmigrations, yet if men would sufficiently purge them while in the body, they would, on leaving it, be reunited to the Deity. His golden verses, attributed by some to one of his disciples, are an exact copy of his sentiments. Whether we regard him as a collector of ancient lore, or the author of the discoveries in science usually ascribed to him, it must be evident, from our articles on astronomy, geometry, music, &c. that he was the most extraordinary of all the ancient philosophers. In arithmetic, the common multiplication table is to this day called Pythagoras's Table. In geometry, besides many others, he invented the three following theorems,—that only three polygons can fill up the space about a point, viz. the equilateral triangle, the square, and the hexagon,—that the sum of the three angles of every triangle, is equal to two right angles,—and that, in any right-angled triangle, the square in the longest side is equal to the squares on the two shorter sides. It is supposed that he also discovered and maintained the true system of the world, which places the sun in the centre and makes the planets revolve about him. This system, which was revived by Copernicus, is from him styled the old or Pythagorean system.

PYTHAGOREANS, the followers of Pythagoras in regard to his moral and theological, or metaphysical opinions. See Pythagoras.

PYTHIAN GAMES, sports instituted near Delphos in honour of Apollo, on account of his slaying the serpent Python. For this feat, though some think rather from his being consulted by the oracle at Delphos, he was styled *Pythius.* The priestess of the temple who delivered the oracles was called Pythia, and any person who was consulted in a similar manner as to future events received the name Pythoness. The games, when first instituted, were celebrated only once in nine years, but afterwards every fifth year, from the number of the nymphs who came to congratulate Apollo on his victory.

PYTHON, in fabulous history, a monstrous serpent, said to have been produced by the earth after Deucalion's deluge. Juno, in a fit of jealousy, commanded this serpent to destroy Latona; but fleeing from the pursuit of the monster, she escaped to Delos, where she was delivered of Diana and Apollo, the latter of whom at length destroyed the serpent with his arrows.

# Q.

Q, The sixteenth, or, counting J as a consonant, the seventeenth letter of the English alphabet. This letter was not used among the Greeks, old Romans, or Saxons, and it is probable that, in the later Latin language, it had the sound of *ch*, which it still bears in the French. Among us, though it is named *kew,* it has always, in words and syllables, a compound sound, as it is always accompanied with U, and in that combination it is sounded like *kw.* In legitimate English words, it never ends a word or syllable. Among the Romans it was employed as a numeral, and, like D, stood for 500, and, with a dash over it, for 500,000. It was also employed as an abreviation chiefly for first names, as Q. *Quintus,* or Q. Quintius. It is still used in the same manner. Thus *q. s.* in medical receipts, *quantum sufficeat,* as much as is sufficient; *q. l.*, means *quantum libet,* as much as you please. In mathematics, Q. E. D. stands for *quod erat demonstrandum,* which is to be demonstrated; and Q. E. F. for *quod erat faciendum,* which was to be done.

QUACHILOT, the Brazilian name of the *porphyrio Americanus,* a beautiful bird found in Brazil. It frequents watery situations, and lives upon fish; but its flesh is well tasted. The male imitates the crowing of the common cock.

QUACK, or imperic, a practitioner of medicine who has either not been regularly educated for the profession, or disgraces it by vending *nostrums* or medicines, the composition of which he keeps a secret, and which, from the number and diversities of the cases they are pretended to cure, are calculated to do much mischief among the credulous and ignorant. Many of the patent medicines now sold in this country are of this description, and perhaps there never was a time when quackery was so much patronized as at present.

QUADRAGESIMA, a name given to the season of Lent, as consisting of forty days.

QUADRANGLE. See Mathematics.

QUADRANS, a name given in former times to the fourth part of an English penny. This coin, previous to the reign of Edward I., was the smallest used, and was marked with a cross, so that it might be cut into four equal parts. See Money.

QUADRANT properly signifies the quarter of a circle, either as to its circumference, of which it includes 90°, or as to the space bounded by that circumference, in which last sense the quadrant is a three-sided figure, bounded by two radii, and the circular arc of 90° which they intercept. Hence, the same name is given to several mathematical instruments used in surveying, astronomy, and navigation,—for measuring angular distances, and taking the altitude of the heavenly bodies. The construction of quadrants differs according to the purpose for which they are employed: But they all agree in having two straight sides equal to the radii of the circle of which they form a part; a circular edge, divided into degrees and parts of a degree; an index turning round the centre, and crossing the quadrantal arc; and sights, or a telescope, for observing the object whose angular distance or altitude is to be taken.

The *surveying quadrant* has been described under Mensuration, and a figure of it is given in Plate 157, Fig. 1. The ordinary *astronomical quadrant* is generally of a large size, and formed of brass or wooden bars faced with iron plates. Its arc, or limb, is accurately divided into degrees and minutes, and, where the size will admit of it, into seconds. It is usually fitted up with two telescopes, one fixed to one side, and the other moveable on the index. It is moved in different directions by means of toothed wheels. When this instrument is turned horizontally on its axis, and the heavenly body to be observed is seen through the moveable telescope, the number of degrees, minutes, &c. intercepted on the graduated arc, show the altitude required. See Astronomy. Astronomical quadrants are sometimes of such a large size that they are suspended by their centre on a wall, and are then called *mural* quadrants. The most celebrated of these large quadrants are those of Graham and Bird, in the observatory of Greenwich. The former is constructed chiefly of iron, with a limb composed partly of iron and partly of brass, with a radius of nearly eight

# QUADRANTS

PLATE 157.

Fig. 7.

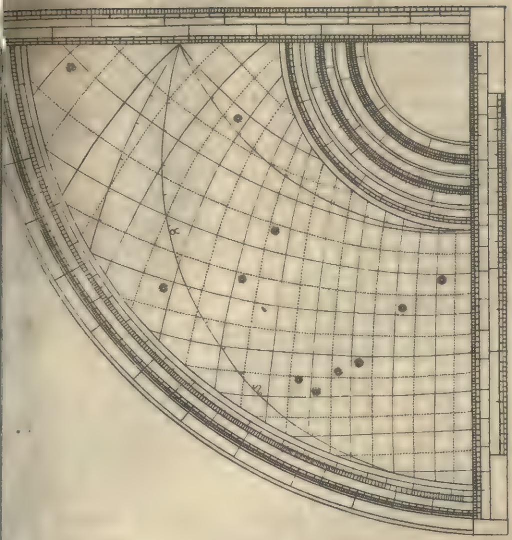


Fig. 5.

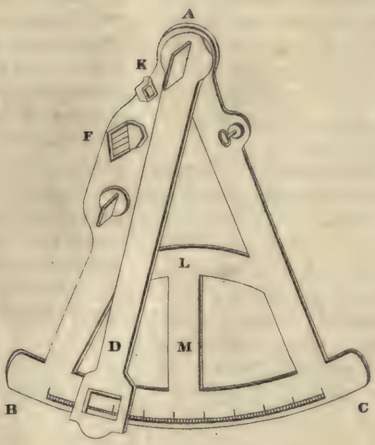


Fig. 2.

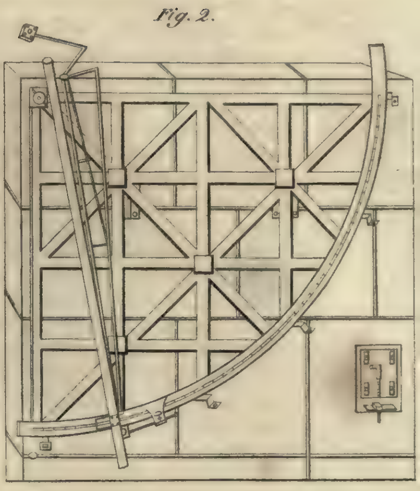


Fig. 4.

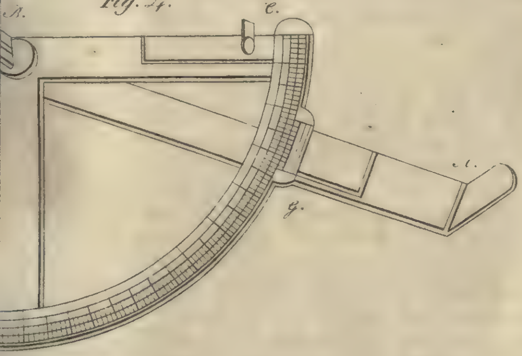


Fig. 3.

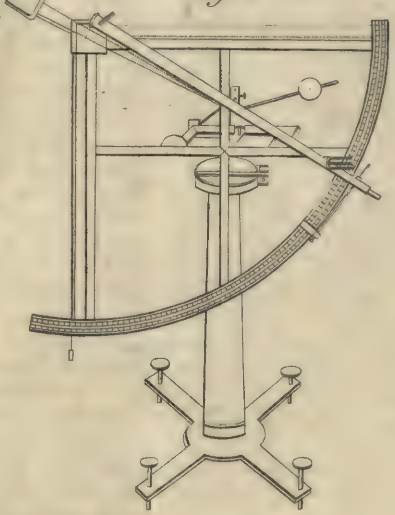


Fig. 1.

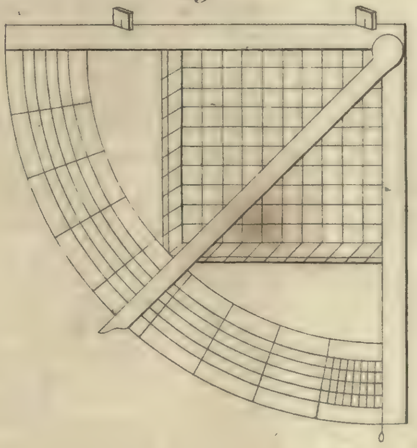


Fig. 6.

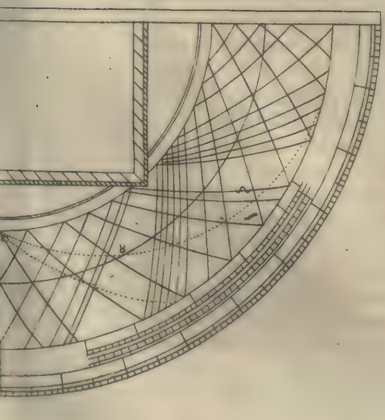


Fig. 8.

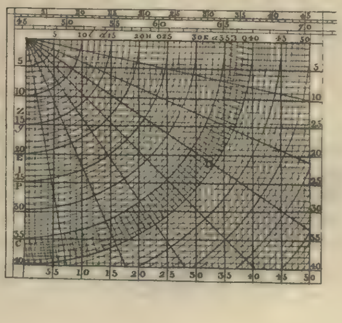
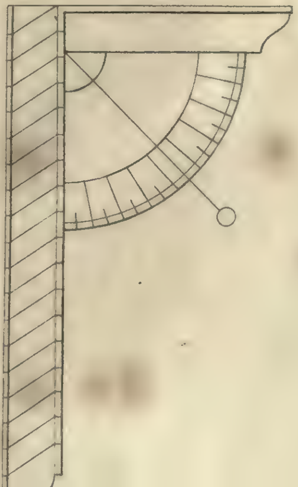


Fig. 9.



feet. The latter is of brass, and has also a radius of eight feet. See Fig. 2. The common astronomical quadrant is rendered portable, by attaching it to a stand, which can be fixed by feet or screws in any convenient situation. See Fig. 3.

*Cole's quadrant,* for astronomical and nautical purposes, is represented at Fig. 4. It consists of a strong wooden staff or radius A B, near one end of which A is a *vernier,* an arc D E of 90°, with two supporting radii and three vanes; one of which, A, is a brass plate, fixed at the moveable extremity of the staff, has a small hole in the middle, and is called the *sight vane.* Another, B, called the *horizon* vane, is fixed at the centre of the quadrant, but inclined to the former at 45°, and has a slit in the middle. The third, or *shade* vane, C, is a brass plate with a convex lens in it, fixed perpendicularly to an arm, moveable on the upper limb, round a screw at the back, by which it may be adjusted or rectified. To do this, as for taking the altitude of the sun at sea, the vernier line G of the staff is placed opposite a degree on the upper limb of the quadrant, and the screw carrying the shade vane is turned till the glass in that vane come into the same straight line both with the sight and horizon vanes. The observer turning his back to the sun, and holding the quadrant by the staff in a vertical position, opposite the sun, with one hand, looks through the sight and horizon vanes till he sees the horizon through both. He then raises the quadrantal arch on its centre-pin, till the shadow of the shade vane, or the solar spot, shining through its lens fall on the slit in the horizon vane. The number of degrees intercepted between the upper extremity of the arch and the line I, in the first case, or between that extremity and G in the second case, shews the altitude of the sun.

*Hadley's quadrant,* represented at Fig. 5. is an improvement on the preceding, and has been long used instead of it for nautical observations. The body of the instrument consists of an arc, B C, containing only $\frac{1}{8}$ of a circle, but divided both ways into 90 equal parts, with two radii A B, A C, and middle cross bars, L M, to strengthen the arc. It has an index D, moveable round the centre, and furnished, where it crosses the arc, with a vernier scale, that may be fixed at any degree of the arc by a back screw. Perpendicular to the index, just above the centre, is fixed a plain glass mirror, and two other mirrors, inclined to the former, are screwed perpendicularly to one of the radii; but one of them, F, has only the lower half silvered, while the other G has the middle of the glass left transparent, so as to form a slit for looking through. On the same radius, at K, is a double screen of two coloured glasses moving on the same pivot, so that they may be used together or separately, according as the sun is more or less bright. In the figure the screens are fixed so as to fit them for the horizon glass F; but they may be removed and fixed above G, so as to shade the glass G. There are also two side vanes; one with a hole opposite the transparent slit in G, while the other has two holes, one opposite the clear part of F, and the other below its silvered part. This instrument is employed at sea, chiefly for taking the altitude and zenith distance of the sun or stars, which may be done either by a *back* observation, as in Cole's quadrant, or by a *fore* observation; but for the methods of doing it, the reader is referred to Hamilton Moore's *Navigation,* and other practical works on that subject.

*Gunter's quadrant,* Fig. 6. besides the usual arc of 90°, and two sight vanes on the radius next the degree of 90°, has drawn on it a stereographical projection of the sphere on the plane of the equinoctial, and a calendar of the months within the graduated edge of the arc. By way of index, there is a plummet line suspended from the centre, with a moveable bead on it. This quadrant will, in some measure, supply the place of a celestial globe. Thus, to find the sun's meridian altitude for any given day of the month, the line is stretched across the division in the calendar marking that day on the arc, and the degree on the latter which it crosses is the altitude. In the same way, when the meridian altitude is given, the corresponding day of the month is found. On sliding the bead along the line till it touch the sun's place in the ecliptic, and if the line be made to cross the arc at the sun's altitude observed with the quadrant, the bead will fall on the hour of the day. Conversely, if the bead be first laid on the sun's place, and then on the given hour, the line will show the altitude on the arc. When the sun's place is known, its declination may be found by setting the bead at the sun's place, and then moving the line to the line of declination, when the bead will show the declination at the time.

*Sutton's quadrant* resembles Gunter's in its uses, and partly in its construction. See Fig. 7. On it is described a stereographic projection of one-fourth of the sphere between the tropics, the eye of the observer being supposed at the north pole. The smaller arch represents one-fourth of the tropic of Capricorn, and the larger one-fourth of that of Cancer; the lines drawn between them and the quadrantal arc are azimuths, and those which cross them at right angles are parallels of latitude. From the point marked 50 at the upper side of the quadrant are drawn four lines, two of which represent the ecliptic, and are marked with the signs of the zodiac, and the other two represent the horizon. The quadrantal arches next the centre contain a calendar of months, and below them is the sun's declination. The limb of the quadrant is graduated both into degrees and hours, and the index is formed by a plummet line.

The *Sinical quadrant,* shown at Fig. 8., is a rectangular board, the surface of which is divided into numerous spaces; first, by concentric quadrantal arches drawn about one corner, A, as centre; then into squares by lines drawn across, perpendicular to each other, and at equal distances; and, lastly, by seven diverging lines drawn from the common centre, so as to form equal angles, and dividing each quadrantal arch into eight equal parts. In this instrument the two sides of the rectangle, which are met by the diverging lines, correspond with the arc or limb of the quadrant, and are, by these lines, divided into eight equal parts or rhumbs, each containing 11° 15′. The other two sides correspond with the radii. The arch B C is divided into 90°; and where there is room, each degree is subdivided into 12 equal parts of

5′ each. To the centre is appended a plumb line to serve as index. The arch B C may represent the horizon, the meridian, or a quadrant of any great circle. When it is taken for the horizon, either of the sides, as A B will represent the meridian, and the other side, as A C, a parallel; the lines parallel to A B will also be meridians, and those which cross them at right angles parallels. If B C be taken for the meridian, A B will represent the common radius of the meridian and equator, and A C half the axis of the globe. The degrees on B C will be degrees of latitude, and the parallels to A B will be the radii to the parallels of latitude and cosines of those parallels. This quadrant is used chiefly in navigation to form triangles similar to what are described by the ship's course with the parallels and meridians, and the sides of these triangles are measured by the equal spaces between the concentric arches and the N. and S. or E. and W. lines. As every fifth division is made longer than the intermediate ones, if each interval is supposed to represent a league, there will be five leagues between every two of the larger divisions; and if the intervals denote four leagues, the latter space will include 10 leagues. By way of example of the mode of using this instrument, suppose the ship has sailed 150 leagues N. E. ¼ N. and makes an angle with the N. part of the meridian of 33° 45′, or three rhumbs. Let A be the place of departure; then, by means of the concentric arch corresponding with the departure, as A E, 150 leagues are reckoned towards D, the point D is the present station of the ship. Again, let D E be the parallel next A C, and the right-angled triangle A E D is similar to that made by the ship's course and the difference of longitude and latitude. Reckoning 20 leagues for each degree, the line A E will measure 135 leagues, or 60° 15′ for the difference of latitude N., while D E gives 83 lesser leagues, which, when reduced, gives the difference of longitude. This case supposes that the ship has sailed on an oblique course. See Navigation.

Besides the purposes already noticed for which quadrants are employed, they are also used by gunners for elevating cannons and mortars. An account of the *Gunner's quadrant*, in Plate 157. Fig. 9, will be given under Gunnery in the treatise on War. The instrument called *quadrant of altitude*, attached to globes, has been described under Geography, Part I. Chap. II.

**QUADRATIC EQUATIONS.** See *Algebra*, under Mathematics.

**QUADRATURE** of the Circle. See Mathematics.

**QUADRILLE.** See Games.

**QUADRUPED.** See Mammalia.

**QUAGGA**, a species of horse, differing from the Zebra in being of a rusty colour, stripped with brown on the fore part, and spotted behind.

**QUAKERS.** This title, which is so generally applied to the religious society of *Friends*, is not acknowledged, or at least not relished by that society, who always call themselves the Friends. In giving a short account of them, we shall first consider how far they differ from other religious sects in their opinions and manners, and then give a short outline of their history.

*Religious opinions.*—The Friends have been accused of holding religious tenets at variance with Scripture, or at least differing materially from what are esteemed the orthodox opinions of the national church establishments; but it will appear, from the following outline of their creed, derived chiefly from their own writers or advocates, that this accusation is unfounded. The Friends believe that there is one God, and they acknowledge the scriptural doctrine of the Trinity, consisting of the Father, the Word, and the Spirit, as combined to form the Godhead. They believe in Christ, as the essential manifestation of the Divinity, by whom all things were made, and as man by his natural birth and human properties, sin only excepted; that he was sent into the world as the Redeemer of sinners, and that he continues to officiate as our mediator and intercessor with the Father. They regard the Scriptures as originating in the inspiration of the Divine Being, and as containing his revealed will; they prefer them to all other books, and hold them in the highest veneration; but they object to calling them the *word of God*, because they consider that title peculiarly applicable to Christ.—They believe in the resurrection of the dead, and hold that on that event the soul of man will be united to a celestial body, superior to that in which it is now clothed. They believe that man was originally created in a state of innocence, but that, through ambition and yielding to temptation, he fell from that state, and is now subject to original sin, derived from his erring first parents, and incapable of virtue or godliness, except through the spirit of divine grace. They consider the redemption of man, and the atonement for his sins, by the sacrifice of Christ, as ascribable only to the mercy and love of God towards his fallen creatures, and that we are saved by faith in Christ, and enabled to lead a *Godly life* by his holy spirit working in us. They acknowledge the necessity of private and public worship, but deem it unnecessary to use any particular rites or ceremonies in that worship; and believe that mere meditation and mental prayer are sufficient to call down the grace of God, unless the Holy Spirit should excite them to more active devotion, and exhortation to their brethren. They pay no particular respect to a place of worship as the house of God, farther than observing silence and decorum while assembled there. They regard a particular course of study as unnecessary to qualify a person for the ministerial office, and think that the exercise of that office depends entirely on the influence of the Spirit, and that any member of their community, whether male or female, may perform public religious duties. They appear to think the sacraments of baptism and the Lord's supper, as usually performed in public, unnecessary ceremonies.

*Singular opinions and manners.*—Interpreting the maxim of Christ and his apostles, swear not at all, in a literal sense, they hold it unlawful, or at least unscriptural, to take an oath, even in a court of justice. Considering the Gospel as the means of promoting peace and good-will among men, they hold war to be in direct hostility to that Gospel, and will not countenance or support it by their contributions, or willingly pay taxes levied for that purpose. They refuse to call the months and days of the week by their several names, and distinguish them by numbers; because, as those names are derived from heathen deities and heroes, they regard them as reliques of superstition and idolatry. It is a principle with them to avoid adulation, and, therefore, they address individuals in the second person singular, and in writing by their simple names without title or designation. As they observe the utmost simplicity of manners, their dress is plain, though often of costly materials, and they never wear mourning, or join in the usual marks of public rejoicings. Their religious and moral concerns are managed at stated meetings of the community, held monthly, quarterly, and annually. The monthly meetings are the least, and the yearly meetings the most numerous. At the former, the private concerns of the society are chiefly attended to; as the maintenance of their poor, the education of children, the admission of new members, proposals of marriage, and the settlement of disputes, and exhorting the disorderly. The authority of the quarterly meetings is superior to that of the monthly, but inferior to that of the yearly meetings, to which last final appeals are made, and the general business of the society is transacted. Their marriages are solemnized in public, but without the assistance of a priest.

*History.*—About 1647, the society of Friends appears to have originated with George Fox, who first promulgated their peculiar tenets, and on that account suffered persecution. It is said that the name Quakers was contemptuously bestowed on them during an examination of Fox, because he exhorted his examiners to *tremble* at the word of the Lord. During the government of Cromwell, their persecution continued, and they were subjected to personal abuse, and even corporal punishment. The restoration of the Stuarts, though it seems to have put a stop to corporal punishment, rather added in other respects to the sufferings of the Friends; heavy fines were imposed upon them; they were often imprisoned for years, sometimes for life, and many were banished from the kingdom. These enormities, though great in England, were still greater in America, especially in New England, where Quakers were forbidden to reside, and where some of them even suffered death. These rigorous penalties were indeed alleviated by Charles the II. and still more by James II.; but they did not obtain the legal protection of government till after the revolution. They were much favoured by William III., and, with few exceptions, they have ever since enjoyed religious toleration, and many civil immunities. In particular, their affirmation is taken in courts of justice as equivalent to the oath of other witnesses. See Fox George, and Penn.

As the discipline of the Friends, and the objects of their several meetings, are points very little understood, it is but justice to that benevolent society to insert here the following clear and interesting account of them, from a pamphlet published in 1799, under the authority of the society.

" *Discipline.*—The purposes which our discipline hath chiefly in view, are, the relief of the poor,—the maintenance of good order,—the support of the testimonies which we believe it is our duty to bear to the world,—and the help and recovery of such as are overtaken in faults.

" In the practice of discipline, we think it indispensable that the order recommended by Christ himself be invariably observed, see Matth. xviii. 15 to 17.

" To effect the salutary purposes of discipline, meetings were appointed, at an early period of the society, which, from the times of their being held, were called quarterly meetings. It was afterwards found expedient to divide the districts of those meetings, and to meet more frequently; from whence arose monthly meetings, subordinate to those held quarterly. At length, in 1669, a yearly meeting was established, to superintend, assist, and provide rules for, the whole, previously to which, general meetings had been occasionally held.

" A monthly meeting is usually composed of several particular congregations, situated within a convenient distance from each other. Its business is to provide for the subsistence of the poor, and for the education of their offspring; to judge of the sincerity and fitness of persons appearing to be convinced of the religious principles of the society, and desiring to be admitted into membership; to excite due attention to the discharge of religious and moral duty; and to deal with disorderly members. Monthly meetings also grant to such of their members as remove into other monthly meetings, certificates of their membership and conduct; without which they cannot gain membership in such meetings. Each monthly meeting is required to appoint certain persons, under the name of overseers, who are to take care that the rules of our discipline be put in practice; and when any case of complaint, or disorderly conduct, comes to their knowledge, to see that private admonition, agreeably to the gospel rule before mentioned, be given, previously to its being laid before the monthly meeting.

" When a case is introduced, it is usual for a small committee to be appointed, to visit the offender, to endeavour to convince him of his error, and to induce him to forsake and condemn it. If they succeed, the person is by minute declared to have made satisfaction for the offence; if not, he is disowned as a member of the society.

" In disputes between individuals, it has long been the decided judgment of the society, that its members should not sue each other at law. It therefore enjoins all to end their differences by speedy and impartial arbitration, agreeably to rules laid down. If any refuse to adopt this mode, or, having adopted it, to submit to the award, it is the direction of the yearly meeting that such be disowned.

" To monthly meetings also belongs the allowing of marriages; for our society hath always scrupled to acknowledge the exclusive authority of the priests in the solemnization of marriage. Those who intend to marry appear together and propose their intention to the monthly meeting; and if not attended by their parents and guardians, produce a written certificate of their consent, signed in the presence of witnesses. The meeting then appoints a committee to enquire whether they be clear of other engagements respecting marriage; and if, at a subsequent meeting, to which the parties also come and declare the continuance of their intention, no objections be reported, they have the meeting's consent to solemnize their intended marriage. This is done in a public meeting for worship, towards the close whereof the parties stand up, and solemnly take each other for husband and wife. A certificate of the proceedings is then publicly read, and signed by the parties, and afterwards by the relations and others as witnesses. Of such marriage the monthly meeting keeps a record; as also of the births and burials of its members. A certificate of the date, of the name of the infant, and of its parents, signed by those present at the birth, is the subject of one of these last mentioned records; and an order for the interment, countersigned by the grave-maker, of the other. The naming of children is without ceremony. Burials are also conducted in a simple manner. The body, followed by the relations and friends, is sometimes, previously to interment, carried to a meeting; and at the grave a pause is generally made; on both which occasions it frequently falls out, that one or more Friends present have somewhat to express for the edification of those who attend; but no religious rite is considered as an essential part of burial.

"Several monthly meetings compose a quarterly meeting. At the quarterly meeting are produced written answers from the monthly meetings, to certain queries respecting the conduct of their members, and the meeting's care over them. The accounts thus received are digested into one, which is sent, also in the form of answers to queries, by representatives, to the yearly meeting. Appeals from the judgment of monthly meetings, are brought to the quarterly meetings; whose business also it is to assist in any difficult case, or where remissness appears in the care of the monthly meetings over the individuals who compose them.

"The yearly meeting has the general superintendence of the society in the country in which it is established; and, therefore, as the accounts which it receives discover the state of inferior meetings, as particular exigencies require, or as the meeting is impressed with a sense of duty, it gives forth its advice, makes such regulations as appear to be requisite, or excites to the observance of those already made; and sometimes appoints committees to visit those quarterly meetings which appear to be in need of immediate advice. Appeals from the judgment of quarterly meetings are here finally determined; and a brotherly correspondence, by epistles, is maintained with other yearly meetings.

"In this place, it is proper to add, that, as we believe women may be rightly called to the work of the ministry, we also think that to them belongs a share in the support of our Christian discipline; and that some parts of it, wherein their own sex is concerned, devolve on them with peculiar propriety; accordingly, they have monthly, quarterly, and yearly meetings of their own sex, held at the same time and in the same place with those of the men; but separately, and without the power of making rules: and it may be remarked, that, during the persecutions, which in the 17th century occasioned the imprisonment of so many of the men, the care of the poor often fell on the women, and was by them satisfactorily administered.

"In order that those who are in the situation of ministers may have the tender sympathy and counsel of those of either sex, who, by their experience in the work of religion, are qualified for that service, the monthly meetings are advised to select such, under the denomination of elders. These, and ministers approved by their monthly meetings, have meetings peculiar to themselves, called meetings of ministers and elders; in which they have an opportunity of exciting each other to a discharge of their several duties, and of extending advice to those who may appear to be weak, without any needless exposure. Such meetings are generally held in the compass of each monthly, quarterly, and yearly meeting. They are conducted by rules prescribed by the yearly meeting, and have no authority to make any alteration or addition to them. The members of them unite with their brethren in the meetings for discipline, and are equally accountable to the latter for their conduct.

"It is to a meeting of this kind in London, called the second day's morning meeting, that the revisal of manuscripts concerning our principles, previously to publication, is entrusted by the yearly meeting held in London; and also the granting, in the intervals of the yearly meeting, of certificates of approbation to such ministers as are concerned to travel in the work of the ministry in foreign parts; in addition to those granted by their monthly and quarterly meetings. When a visit of this kind doth not extend beyond Great Britain, a certificate from the monthly meeting of which the minister is a member is sufficient; if to Ireland, the concurrence of the quarterly meeting is also required. Regulations of similar tendency obtain in other yearly meetings.

"The yearly meeting of London, in the year 1675, appointed a meeting to be held in that city for the purpose of advising and assisting in cases of suffering for conscience sake, which hath continued with great use to the society to this day. It is composed of Friends under the name of correspondents, chosen by the several quarterly meetings, and who reside in or near the city. The same meetings also appoint members of their own in the country as correspondents, who are to join their brethren in London on emergency. The names of all these correspondents, previously to their being recorded as such, are submitted to the approbation of the yearly meeting. Those of the men who are approved ministers are also members of this meeting, which is called the meeting for sufferings, a name arising from its original purpose, which is not yet become entirely obsolete.

"The yearly meeting has intrusted the meeting for sufferings with the care of printing and distributing books, and with the management of its stock; and, considered as a standing committee of the yearly meeting, it hath a general care of whatever may arise during the intervals of that meeting, affecting the society, and requiring immediate attention, particularly of those circumstances which may occasion an application to government.

"There is not in any of the meetings which have been mentioned any president, as we believe that Divine Wisdom alone ought to preside; nor hath any member a right to claim pre-eminence over the rest. The office of clerk, with a few exceptions, is undertaken voluntarily by some members, as is also the keeping of the records. Where these are very voluminous, and require a house for their deposit, (as is the case in London, where the general records of the society in Great Britain are kept,) a clerk is hired to have the care of them; but except a few clerks of this kind, and persons who have the care of meeting-houses, none receive any stipend for their services in our religious society."

QUANG-TONG, a province of China. See China.

QUANTITY, any thing that can be weighed or measured, as matter, space, time, &c. See Mathematics.

QUARANTINE, a state of confinement and restraint, imposed on persons and goods arriving at a place from a country infected with or subject to the plague, or other dangerous pestilential diseases, to prevent the introduction of those diseases. The term is most commonly applied to ships arriving at a port, especially from the Levant. Such ships are moored in a sequestered spot, and the crew and passengers are prohibited from all intercourse with the shore, or from landing any of the cargo, for a certain time, which varies according to circumstances.—When the ship leaves one of those diseased or suspected ports, she is furnished by the consuls with a certificate, stating the health of the port and of the crew. These certificates are called *bills of health*, and are *clean*, *suspicious*, or *foul*, according to the state of health. A clean bill denotes that the port and crew are then free from plague; a suspicious bill, that there is plague in the place, but that it is not common, and the ship is said to be *touched*; while a foul bill indicates the plague to be raging at the port. Under the first, the ship is obliged to *perform* quarantine only for a few days, from three to eight; under the second the time is extended, but seldom exceeds fifteen days; but with a foul bill, from forty to sixty days is not uncommon. The quarantine establishment is under the superintendence of a medical man, with several subordinate officers, and attached to it is a *lazaretto*, that is, a ship, or an insulated building on shore, for receiving the goods, and such of the passengers as are sick. The goods are examined, and sorted according to their nature and supposed capability of receiving or retaining pestilential *effluvia*; goat skins, hare skins, carpets, and other woollen stuffs, silk and cotton, being considered the most dangerous. They are removed to the lazaretto, and put into the hands of persons called *expurgators*, whose duty is to rip open the packages on one side, and expose them to a current of free air for the prescribed term, at the end of which, they sew them up again, and return them to the ship. The regulations are most strict when a ship arrives with persons actually affected with the plague; a circumstance which is signified by the vessel hoisting a yellow flag with a black ball in the middle. In this and other aggravated cases, the ship and cargo are sometimes destroyed, and paid for by the government.

The practice of quarantine has long been enforced by the maritime powers of Europe, with the exception of Holland. It originated in the belief that persons and goods are capable of conveying the contagion of plague to places very distant from the original seat of the disease. It was first established in Britain in 1709; and, with some modifications, still continues. The laws respecting it were new-modelled in 1800, and were revised in 1818. The principal English quarantine stations are at Standgate Creek, near Rochester, at Portsmouth, Falmouth, Bristol, Milford, Liverpool, and Hull.

The practice is liable to several objections, especially in countries so remote from the usual seat of disease as Britain, where, from the length of a Levant voyage, it is barely possible that contagion should be introduced either by persons or goods. The inconvenience to which it exposes the ship, the crew, and passengers, as well as the merchants engaged in the trade, causes it to be considered vexatious; and it is often eluded, or rendered nugatory, by false or fabricated bills of health. Still it is useful as a matter of caution, and the British legislature have judged wisely in continuing it, under the present modifications. See Plague.

QUARLES, Francis, an English writer of the 17th century, distinguished more for his loyalty and consistency, than for the value of his productions, was born at Rumford in Essex, in 1692. He was educated at Christ Church college in the university of Cambridge; and being destined for the bar, was afterwards entered a student of Lincoln's Inn. On the marriage of the daughter of James I. to the king of Bohemia, Mr Quarles accepted the office of cup-bearer to her Majesty; but did not remain long abroad. After his return, he was appointed secretary to Archbishop Usher in Ireland; but in consequence of the rebellion of 1641, in which he lost most of his property, he was obliged to quit that kingdom. About the same time he held the situation of chronologer to the city of London, and enjoyed a pension from Charles I. for some writings on theology, which were then held in much esteem. During the civil war, one of the publications, entitled the Royal Convert, gave such offence to the parliament, that, on the decline of the royal authority, the author was punished by the confiscation of his property, books, and papers. He had always manifested a zealous attachment to the royal cause, and had attended the king in his retreat to Oxford. He was therefore deemed a fit object of vengeance by the popular party. He died in 1644. Quarles is reckoned among the British poets, but his pretensions to that title are very slight. His principal work is *Divine Emblems*, a series of prints, illustrated by lines attached to each print.

QUARTER. This term has various significations in the arts and sciences. In *naval architecture* it denotes that part of a ship which is between the stern and the mid-ships, and hence the uppermost deck in that situation is called the *quarter*-deck. See Ship-building. In *Heraldry*, the arms of one family are said to be *quartered* with those of another, when they occupy in miniature an upper corner of the shield belonging to the latter. See Heraldry.—The term Quarters, in *military affairs*, signifies either the town or place in which soldiers are lodged for the time, or the post to which they are called in cases of emergency; and in a battle, Quarter! is the exclamation made by soldiers who wish to preserve their life at the expense of their liberty.

For *Quarter*-Sessions see Sessions.

QUARTZ, a siliceous stone. See Geology.

QUASSIA, a genus of plants belonging to the class Decandria. See Botany and Materia Medica.

QUEBEC, the capital city of Canada, in North America. It is situated on high ground, on the north-west side of the river St Lawrence, where that river is contracted to the breadth of about three quarters of a mile, and below it is a harbour capable of containing 600 ships of the line. It is divided into the Upper and Lower Towns, of which the latter is 15 feet below the level of the former, and is separated by steep rocks. The streets are irregular but well paved, and the houses are built chiefly of stone. The principal buildings are the castle of St Louis, the court-house, the Protestant cathedral, the Catholic cathedral, the New jail, the Artillery barracks, and the Ursuline church and convent. Quebec is strongly fortified, and contains about 18,000 inhabitants. W. Lon. 71° 5′, N. Lat. 46° 48′.

QUEENBOROUGH. See Kent

QUEEN CHARLOTTE'S ISLANDS, a group of islands in the South Pacific ocean, discovered, 1767, by Captain Carteret, between 163° and 165° E. Long. and between 10° and 11° S. Lat. They are in general fertile and inhabited. The principal are Egmont's island, or New Guernsey, and Lord Howe's island, or New Jersey.

QUEEN CHARLOTTE'S SOUND. See Zealand, New.

QUEEN'S COUNTY, a county of Ireland, in the province of Leinster, bounded on the north and west by King's county, on the east by Kildare and part of Carlow, on the south by Kilkenny, and on the south-west by Tipperary. Its length and breadth are nearly equal, 32 miles. Its area is computed at 590 square miles, or 378,023 English acres. In form this county resembles a parallelogram, and its general aspect is irregular and hilly, especially on the north. The soil in most parts is clayey or loamy, with here and there loose gravel mixed with clay or loam, and in general the surface of the level ground is wet and boggy. There are two principal mountainous ridges, the Heibh-bloom, between this and King's county, impassible except by the narrow defile called the Gap of Glandine, and the Dysart hills. Many streams water the county, but the chief are the Barrow and the Nore, which rise among the hills. Only the former is navigable. A canal has been made between Athy on the Barrow, and Dublin. The bogs are numerous but not deep, and afford plenty of turf for fuel. The principal minerals are limestone, of which there are numerous and productive quarries; coal, similar to that of Kilkenny, abounding chiefly in the eastern district; marble, freestone, marle, ochre, fuller's earth, iron, copper, and manganese. Wood has been rendered scarce by the progress of cultivation. The population of the county, in 1821, amounted to above 130,000. The county is divided into eight baronies and 150 parishes. The agriculture is respectable; there are many dairy farms, and a considerable quantity of cheese is made, chiefly for the Dublin market. The proportion of arable and pasture land is computed at 210,000 acres, and the bogs occupy about 16,000 acres. The principal manufactures are those of linen and coarse woollen stuffs. The commerce is chiefly inland, and consists in the exportation of corn, butter, cheese, and similar land productions. The county sends two members to parliament, besides one for the borough of Portarlington. The chief towns are Maryborough and Portarlington.

*Maryborough*, so named, like the county, from Queen Mary, consort of William III., is the county town, but not now a borough, having, from its want of consideration, been disfranchised at the Union. It is pleasantly situated on the Barrow, 43 miles south-west of Dublin. Woollen stuffs are manufactured here.

*Portarlington*, partly in King's county, is situated on the Barrow, about 36 miles south-west of Dublin; consists of one principal street; is populous, and contains several good schools, on account of which it is much resorted to by genteel families. It is the only borough in the county.

QUEENSFERRY, South, a small sea-port and borough town on the south side of the frith of Forth, containing about 600 inhabitants. It is an irregular and ill built town, and is supported chiefly by its ferry and the fisheries in its neighbourhood. Near it are several good stone piers, for the accommodation of passengers and goods; and on the north pier are a light and watch-house. It is governed by a provost, a land-bailie, two sea-bailies, and a dean of guild.

QUERCITRON, the bark of the *quercus tinctoria*, employed as a dye-stuff. See Dyeing.

QUERCUS, the *oak*, a genus of plants belonging to the class Monoecia. See Botany and Gardening.

QUESNAY, Francois, a celebrated medical practitioner and political economist of France, was born 1694. He was descended from a humble family, and his early education was much neglected; but his subsequent attainments in his profession and in general literature, were such as to entitle him to high rank among the eminent persons of the age in which he lived. After serving his apprenticeship with a country surgeon, by whom he was instructed in the Greek and Latin languages, he repaired to Paris, where he made considerable progress in the study of medicine and metaphysics. He afterwards settled as a surgeon at Nantz; and, in 1718, was admitted a member of the college of surgeons in that town. Being employed to attend the family of the Duke de Villeroi, he was induced, in 1730, to accompany that nobleman to Paris as his family surgeon. His eminence in his profession, and the interest of Madame Pompadour, procured him the appointment of surgeon in ordinary to Louis XV.

Having been nominated secretary to the academy of Surgery at Paris, the labours of that office so much impaired his health, that he determined to relinquish practice as a surgeon, took the degree of M. D. in 1744, and was appointed consulting physician to the king; in which capacity he attended his royal master in the campaigns of 1744 and 1745. He was soon after raised to the rank of nobility in consequence of the successful inoculation of the dauphin for the small-pox. About 1756 he turned his attention towards political economy, and contributed some valuable articles in that department to the Encyclopedie. He continued to enjoy deserved celebrity, as a practitioner and a writer, till his death, which happened at Versailles in 1774. Quesnay's principal medical works are on continued fevers, suppuration, and gangrene; and his most esteemed writings on political economy are his *Tableau Economique,* and his *Maximes Generales de Gouvernement Economiques.*

QUICKSILVER, or MERCURY. See CHEMISTRY and GEOLOGY.

QUILLS.—The quills of several birds are employed for making writing pens; but those of the *goose,* both wild and tame, the *swan,* and the *crow,* are generally preferred. Crow-quill pens are much used in drawing and designing, especially in what is called *etching,* in imitation of prints. Goose and swan quills form an important article of trade and commerce; for as the quantity collected at home is comparatively very small, they are imported in great numbers, chiefly from Hudson's bay and the Baltic. The preparation of these quills for making pens constitutes a particular art or trade, called quill-dressing; and the quill-dresser, who is also a pen-maker, supplies the bookseller and stationer with the produce of his labours.

Quills, in their natural state, are covered with a membranous skin, and are so soft and tough as not to split easily. They are also opaque, and the vascular membrane within the barrel adheres so strongly as not to be easily detached. Hence, they are very unfit for making good pens; and the object of the quill-dresser is to remedy these defects. He receives the quills in large promiscuous bundles, just as they are taken from the wing. His first business is to sort them, according to their size and quality. Those of the largest size and longest barrel are called *primes,* and are set aside for making the best and dearest quills. The next in point of size and quality are called *seconds*; and the smallest and shortest are denominated *pinions.* He next proceeds to *clarify* them; which is done by plunging them for a short time into heated sand, and scraping them with a sharp instrument. The heat of the sand makes the outer skin crack and peel off, shrivels up the internal membrane, so that it falls to the point of the quill, and, by consuming and drying up the oil, renders the barrel hard and transparent, in proportion to the degree of heat applied. For the finest quills the heating is repeated several times, taking care not to carry it so far as to injure the barrel. This process is called *dutching,* as it is supposed it was first practised in Holland. The quills thus dutched, are either white or of the colour of fine thin horn. To give them a yellow colour, and make them split more easily, they are dipped in weak nitric acid or *aquafortis;* but this, though it improves their beauty, makes them too brittle, so that the pen will not bear much pressure. After dutching, the broad barbs on the inner edge of the quill are usually stripped off to make the quills lie closer together, and they are made up into bundles, commonly of twenty-five each, and bound tightly round with coloured twine.

In judging of quills, the length and size of the barrel are chiefly regarded, provided they be sufficiently hard. Though most persons prefer a very transparent and even a yellow quill, practised writers, especially in public offices, chuse such as are rather opaque, as being more durable. Swan quills, though very expensive, being generally sold at from 4d. to 6d. each, are in the end the cheapest, as with care they last a very long time, and are particularly suited to large hand. Pinions make excellent pens for small writing, and are well adapted to the use of ladies and children. See PEN.

QUILOA, a kingdom of Africa occupying part of its eastern coast, with a capital of the same name. The city of Quiloa was formerly a large and important place, and the seat of a factory belonging to the Portuguese; but it is now a small sea-port town, situated on an island at the mouth of the river Coavo, and consists of a few wretched huts, with a small fort mounting three guns, and a Turkish garrison of not more than twelve soldiers, kept to overawe the inhabitants of the country who are tributary to Turkey. It formerly carried on an extensive traffic in slaves; but the annual number now exported scarcely exceeds 600.

QUIMPER, a town in France. See FINISTERRE.

QUIN, JAMES, an eminent English actor, was born at London 1693. He received a liberal education, and was designed for the profession of the law; but a volatile disposition, and a taste for the dissipations of the metropolis, induced him to disappoint the wishes of his friends, and attach himself to the stage. For many years he maintained much celebrity as a tragedian, and was thought by some a not unsuccessful rival to Garrick. He was remarkable for wit and humour, and his society, as a convivial companion, was much courted by his contemporaries, even among the great. He was patronised by Frederick, prince of Wales, and was employed by him to instruct his sons in the graces of elocution. He died in 1766.

QUINTILIAN, MARCUS FABIUS, an eminent Roman rhetorician and teacher of oratory, was a native of Spain, and born about A. D. 42. He early went to Rome, where he devoted himself to the study of eloquence, which he taught in public for 20 years, and he was the first teacher in that city who received a salary from the state. He also practised as a pleader at the Roman bar, and acquired great eminence in his profession. He was much favoured by the Emperor Domitian, and was appointed preceptor to his sons. His declining years were passed in literary retirement, and embittered by the death of his wife and two sons. He died about the year 95. His only work extant is the *Institutiones Oratoriae,* which was not known till 1415, when it was accidentally discovered in the tower of an old monastery.

QUINTIN, St. a handsome and well built town of France, in the department of Aisne. It stands partly on the Somme, and partly along two canals. It has a square market-place, with a public well in the middle. The principal buildings are the cathedral, a large edifice, of a very homely appearance externally, but spacious and highly ornamented within; the *Halle au Bled*; the *Maison de Ville* in the market-place; and the *Foundling Hospital.* St Quintin is celebrated for its manufactures of linen, cambric, lawn, gauze, cotton, and thread, in which it carries on an extensive export trade to Holland, Germany, and various parts of France. The town contains about 11,000 inhabitants.

QUINTUS, Curtius Rufus, a celebrated Roman historian, who flourished during the reign of Vespasian, or of Trajan; but the particulars of his life are unknown. He composed a History of Alexander the Great in 10 books,—a work much admired for the purity and elegance of its style. The best edition is that of Elzevir, published at Amsterdam, in 8vo, in 1673.

QUITO, an extensive district of New Granada in South America, with a capital city of the same name. An account of both will be found under America.

## END OF VOLUME FIFTH.

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### *Directions for Placing the Plates of Vol. V.*

#### Part I.

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| Plate 119, opposite to page | 8. | Plate 128, opposite page | 144. |
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#### ERRATA OF VOL. V.

After the last line of page 296, add, residence during thirty years.
Page 363, first line, *for* σλογες *read* λογος.
—— 456, line 21, from the bottom, second column, *for* sabulatum *read* subulatum, and *for* sabulated *read* subulated.
———— 15, from the bottom, *for* loba *read* coba.
—— 457, first col. line third from the top, *for* Lubriciformis *read* Lumbriciformis.
———— line 9. *for* rein *read* rim.
—— 592, 2d col. line 14, from the bottom, *for* Plates *read* Phrenological plates 151 and 152.
—— 638, 2d l. from top, right col. *for* founding *read* foundling.

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